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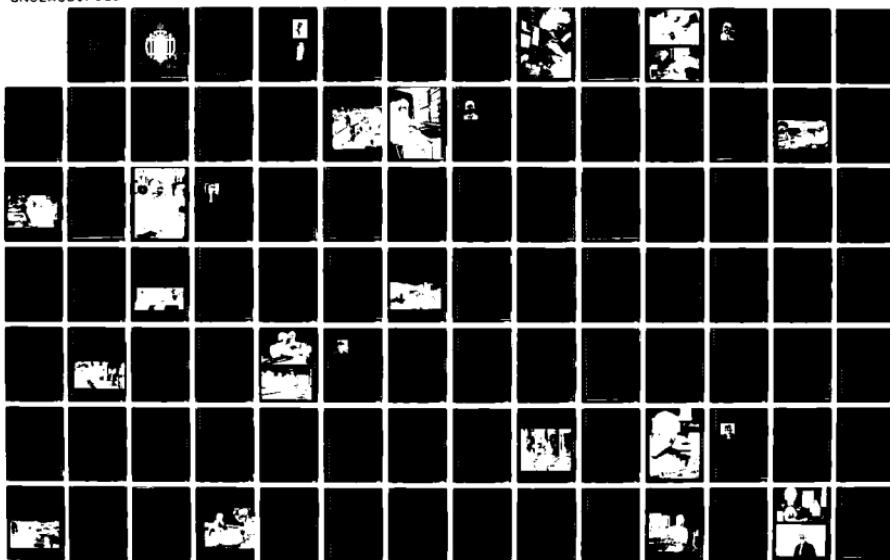
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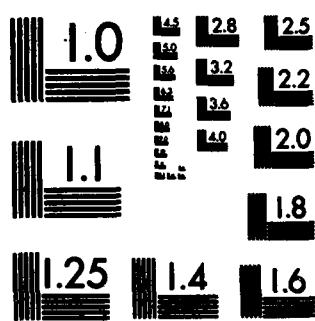
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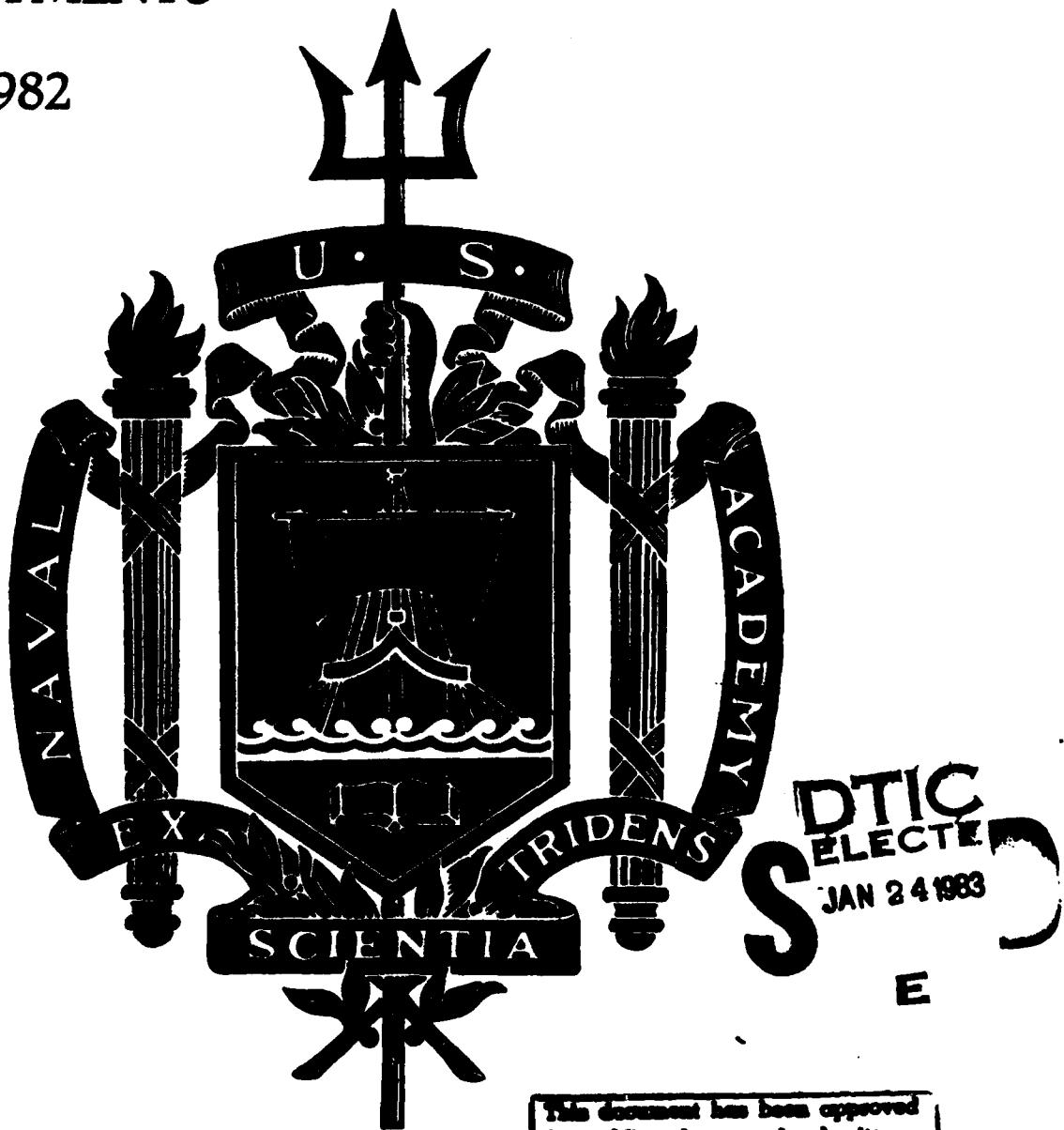
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# SUMMARY OF RESEARCH ACTIVITIES

## ACADEMIC DEPARTMENTS

1981-1982

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UNITED STATES NAVAL ACADEMY  
ANNAPOLIS, MARYLAND

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SUMMARY  
OF  
RESEARCH ACTIVITIES  
1981 - 1982

COMPILED AND EDITED

BY

PROFESSOR WILSON L. HEFLIN  
ENGLISH DEPARTMENT

OCTOBER 1982

UNITED STATES NAVAL ACADEMY  
ANNAPOLIS, MARYLAND  
21402

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**Academic Dean Davidson**



**Associate Dean Mathieu,  
Director of Research**

## FOREWORD

The academic excellence of an educational institution is measured by the achievements of its faculty in teaching, research, and related scholarly endeavors. It is the policy of the Naval Academy to provide and maintain an environment in which research activities that contribute to the professional growth of the faculty and outstanding midshipmen may flourish.

The research activities of the faculty range from very applied cooperative studies with the Navy research and development community to very fundamental investigations concerned with extending the frontiers of knowledge. The broad scope of research described in this annual report reflects the interests and expertise of the participating faculty and midshipmen, as well as the availability of laboratory, library and computer facilities.

This publication was compiled to acquaint the reader with faculty and midshipmen research efforts being done behind the classroom scene. Research results are published in manuscripts, reports, and prestigious journals as well as presented at important professional meetings and conferences. In addition to their teaching and research, the faculty contribute to their profession through participation in professional societies and consulting activities. This publication contains summaries of completed and on-going faculty projects, midshipmen research course projects including the Trident Scholar Program, and lists of presentations and publications. The work reported on was conducted during the period July 1981 through June 1982.

External support continues to increase significantly. This is undoubtedly due to the additional opportunities provided by new laboratories in the Engineering Studies Complex and the initiative of the well-qualified civilian and military members of the faculty. It is important to acknowledge the strong and continuous support provided by the Chief of Naval Research, Director of Navy Laboratories and the numerous activities of the Naval Material Command, without which such progress could not be possible.

Comments and suggestions related to the research efforts will be gratefully received and sincerely appreciated.



BRUCE M. DAVIDSON  
Academic Dean



RICHARD D. MATHIEU  
Director of Research/  
Associate Dean

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DIVISION OF  
ENGINEERING AND WEAPONS



## AEROSPACE ENGINEERING DEPARTMENT

*Commander Paul B. Schlein, USN, Chairman*



As in the past, the Aerospace Engineering Department has emphasized the role of research in the education of midshipmen. Research, beyond being an end in itself, brings an educational institution's process into a full circle, expanding the classroom into experience, frustration, and, sometimes, discovery.

The research reported herein may not seem aerospace-oriented in many cases, but direct application is not the only objective. The "medium is the message" to be taken to the midshipmen.

\*\*\*\*\*

RAGALLO-WING HANG GLIDER STABILITY

Researcher: Midshipman 1/C E. Todd Allen

Adviser: Associate Professor Vadym V. Utgoff

This project involves wind-tunnel determination of the effect of spar flexibility on aerodynamic characteristics of a Ragallo-wing hang glider. The effect of spar flexibility on  $C_L$ ,  $C_N$ ,  $C_M$ , and the location of the aerodynamic center was determined by wind-tunnel tests of a model Ragallo-wing hang glider constructed so that spars of different flexibility may be used.

\*\*\*\*\*

INSTALLATION AND OPERATION OF CENTRIFUGAL BLOWER FACILITY

Researcher: Midshipman Leo D. Balk

Adviser: Assistant Professor John E. Allen

This project involved the installation, instrumentation and operation of a 25-hp Spencer blower in the Aerospace Laboratory for future use in analysis of internal airflow components at mach numbers up to 0.5 in steady operation. The air-delivery duct was designed and fabricated, and will be adaptable to a variety of test sections. The duct was instrumented to include pressure, temperature, and flow-rate sensors. Operating limitations and characteristics were determined for the blower and duct configuration.

\*\*\*\*\*

**NON-LINEAR FINITE-ELEMENT STRUCTURAL ANALYSIS**

Researcher: Midshipman 1/C Edward Campbell

Adviser: Associate Professor William J. Bagaria

The non-linear finite-element structural analysis program GIST is currently under development. This project involved mathematically modeling, using GIST, a typical segment of a submarine hull. This mathematical model was then used to predict the buckling and collapse loads and modes of the hull.

The techniques necessary to model the hull in order to input the data to GIST were developed.

\*\*\*\*\*

**COMBINED COMPUTATIONAL AERODYNAMICS AND FINITE ELEMENT STRUCTURES**

Researcher: Midshipman 1/C Robert Civilikas

Advisers: Associate Professor William J. Bagaria and Commander Paul B. Schlein, USN

The purpose of this project was to combine two computer programs currently in use at the U. S. Naval Academy. The first program, GIFTS, is a finite-element structural analysis program. The second program is a computational aerodynamics program in which a mathematical model of an aircraft fuselage was generated for the aerodynamics analysis. A computer program was then written in order to pass the mathematical model and the aerodynamic loads to the structures program. Evaluation of the structural loads was conducted in the second semester.

\*\*\*\*\*

**COMPUTATIONAL AERODYNAMICS AND STRUCTURES**

Researcher: Midshipman 1/C Robert Civilikas

Adviser: Associate Professor William J. Bagaria

The purpose of this project was to combine two computer programs currently in use at the U. S. Naval Academy. The first program, GIFTS, is a finite-element structural analysis program. The second program is a computational aerodynamics program. A computer model was generated for the aerodynamic analysis. The data from this program were to be reformatted in order that it may be used in the structural analysis program. The project yielded a combined computer program that will compute both the aerodynamic and structural properties of an aerospace vehicle. This combined program can be used as a design tool in EA440.

\*\*\*\*\*

**COMBUSTION-CHAMBER GEOMETRY AND PISTON CAP-ANALYSIS**

Researcher: Midshipman 1/C Michael P. Crowley

Adviser: Assistant Professor John E. Allen

This project involved an analysis of the effects of various combustion-chamber geometries on the flow-field of an internal combustion engine. The study produced high-speed Schlieren motion pictures of the development of various flow-field phenomena to support a factorial analysis into the effect of the variation of four geometric parameters. The edited films will further aid in understanding the combustion and flow-field interactions in the Heat Balanced Engine. Documentation of operating procedures for this unique experimental facility will aid future studies of this kind.

\*\*\*\*\*

**COMPRESSION IGNITION CFR ENGINE**

Researcher: Midshipman 1/C Bruce W. Dudley

Adviser: Assistant Professor John E. Allen

This project involved the modification of a CFR to compression ignition operation for instruction and research use. A fuel pump and injection system were designed and fitted to the engine. Measurements and calculations were made to calibrate the compression ratios of engine operation to micrometer readings obtained and instrumentation was installed to

RESEARCH COURSE PROJECTS

AEROSPACE ENGINEERING DEPARTMENT

give airflow, temperature, and pressure indications for cycle analysis. Stable compression ignition operation was obtained over a wide range of compression ratios and engine speed. Operating and safety procedures were developed for the new engine configuration.

\*\*\*\*\*

**NON-LINEAR CYLINDER BUCKLING**

Researcher: Midshipman 1/C William Laingen

Adviser: Associate Professor William J. Bagaria

Scale-model-aircraft fuselage cylinders were tested to determine their buckling behavior. This project involved the use of the GIST non-linear buckling program, to determine if finite-element techniques can be used to analytically predict the actual buckling modes and collapse load. Analysis was not complete at the end of the semester.

\*\*\*\*\*

**INVESTIGATION OF TWO FLOAT DESIGNS FOR THE BENSEN GYRO-GLIDER**

Researcher: Midshipman 1/C Kenneth W. Silvers

Adviser: Lieutenant Commander Richard A. Everett, USN

The aerodynamic characteristics of two float designs for the Bensen Gyro-Glider were to be determined through wind tunnel tests. The experiment was not completed since wind tunnel data were not developed for one of the designs. However, data were obtained for a split-hull type design formulated for the Gyro-Glider in an earlier report. This design performed fundamentally as expected, generating little lift, developing predominantly parasite drag, and being generally unstable in pitch and yaw. There did exist a certain region in the scope of the test where the floats were stable in yaw, though the exact boundaries of this region were undefinable. The report on this project provides a firm basis for a continuation of the experiment investigating the two float designs.

\*\*\*\*\*

POSITION CONTROL SYSTEM FOR A CANARD NEGATIVE LIFT AIRFOIL  
FOR A MOTORCYCLE

Researcher: Midshipman 1/C Daniel F. Slowikowski

Adviser: Professor Bernard H. Carson

The objective of this project was to use an inverted airfoil to produce a downward force on the wheels of a motorcycle to increase available traction. Since the airfoil will be mounted 4-6 inches above the road surface, the wing must rotate about the longitudinal axis of the motorcycle in order to remain parallel to the road surface as the motorcycle leans. A control system was designed which sensed the wing position relative to the plane of the road surface and used this information to keep the wing parallel to the road. A breadboard controller was constructed and successfully tested by semester's end.

\*\*\*\*\*

RECIPROCATING ENGINE IMPROVEMENT

Researcher: Midshipman 1/C Michael B. Smack

Adviser: Commander Paul B. Schlein, USN

The objectives of this study were to investigate the feasibility and effect of quench (or squish) clearance-reduction and ceramic (plasma sprayed  $ZrO_2$ ) piston tops on the detonation characteristics and durability of a representative automotive reciprocating engine.

The investigation continued work of the previous semester during which engine and instrumentation modifications were determined and performed. Testing, at lower power levels due to waste-heat-rejection limitations, was conducted that demonstrated the feasibility of both concepts. The engine ran successfully to 4000 rpm and 10 inches of vacuum prior to detonation on 87 number ((RON + MON)/2) fuel at unmodified spark advance and mixture ratio.

Further, the ceramic piston-tops remained in good condition and piston-head physical contact did not occur despite .015-inch cold clearance.

Additional testing will be conducted to establish detonation boundaries on various fuels, best spark timing, best mixture ratio and longer term durability.

\*\*\*\*\*

**ANELASTIC COMPLIANT ROTOR**

Researcher: Midshipman 1/C John R. Wassink

Adviser: Associate Professor Vadym V. Utgoff

Performance comparable to that achieved by fixed-wing aircraft coupled with a vertical takeoff and landing and hover capability is a long-standing objective of the VTOL community. Proposals and prototypes with this goal in view have included varieties of powered lift aircraft, tilt-rotor and tilt-wing machines, compound rotorcraft, and airplanes with stoppable and retractable rotor blades.

The latter category has included various concepts involving highly flexible rotor blades capable of being rolled up on a root or tip spindle. One example is the so-called "sail rotor" consisting of leading and trailing edge catenary-cables with cloth or plastic stretched between them. Success has been limited by the phenomenon of luffing, in which blade-camber changes suddenly from positive to negative; and by high-blade profile drag. Attempts have also been made to develop blades consisting of short rigid segments held together by cables. These have not met with success.

The concept tested involved rotor blades fabricated from silicone-rubber-impregnated Kevlar fabric which served as the upper and lower surface and carried tensile loads. The airfoil shape is maintained by suitable stitching between the upper and lower surfaces and the pressure difference between the interior and exterior of the blade. The blades have essentially zero torsional and flapping rigidity and take their shape as a result of aerodynamic and inertia forces; hence the designation "anelastic." Construction of prototype blades was completed and initial testing completed. Analysis of results was underway at semester's end.

\*\*\*\*\*

ALLEN, John E., Assistant Professor, "Computer Simulation of Glider Flight," EW Report, October 1981.

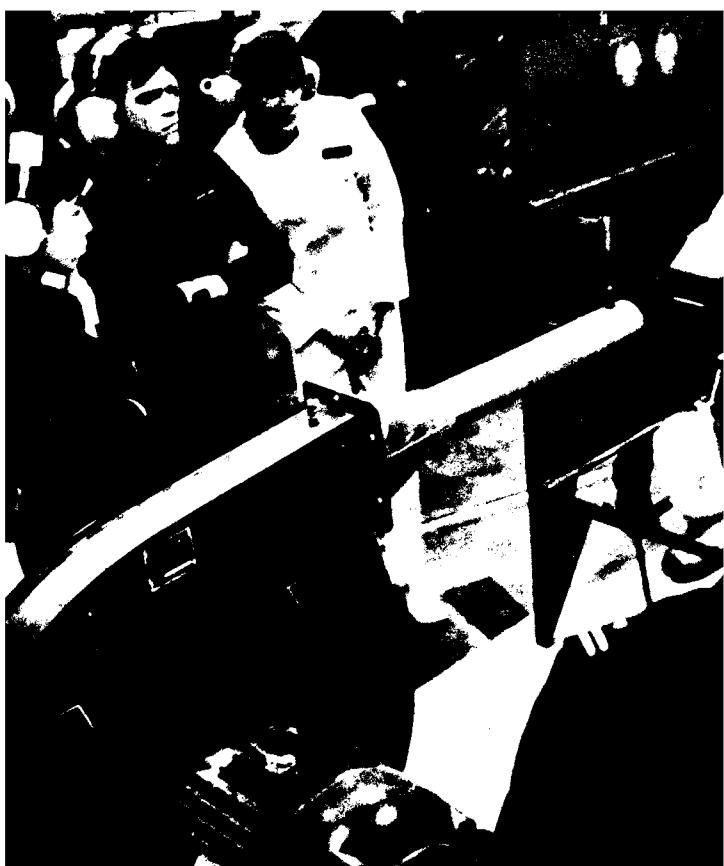
The general equations of unsteady motion were employed to solve for the flight trajectory of a model glider in a quiescent atmosphere. Characteristics were obtained for all aerodynamic surfaces from NACA 0012 airfoil section data at angles of attack from 0° to 180°. A 4th order Runge-Kutta integration technique was used to evaluate flight characteristics first for a model constrained to move only in the vertical plane, then extended to full six degree of freedom flight. Equilibrium conditions were investigated for steady glide and level flight through a Newton-Raphson convergence scheme. Digital computer programs were developed to employ these techniques of flight simulation using the Naval Academy Time Sharing System and BASIC programming language.

\*\*\*\*\*

CARSON, Bernard H., Professor, "Fuel Efficiency of Small Aircraft," Journal of Aircraft, 19 (June 1982), 473-479.

There is a basic mismatch between the amount of power installed in small propeller-driven aircraft and that required for efficient cruising, which results from climb performance requirements. It was shown in this paper that there is a way of using excess power for most efficient cruise, the resulting airspeed coming closest to the Gabrielli-von Karman limit-line of vehicular performance. A survey of 111 light aircraft was conducted, and it was found that many are operated at this optimum, while many more are not. A figure of merit was developed that measures cruise performance. Rationale was presented that is directly applicable to design for cruise efficiency.

\*\*\*\*\*





## ELECTRICAL ENGINEERING DEPARTMENT

Lieutenant Colonel Gerry J. Doucet, CF, Chairman



Research in the Department of Electrical Engineering serves three purposes: it supports continuing development of the faculty; it provides the important element of applied engineering for midshipmen who participate in projects; and it contributes new knowledge to the disciplines. The second of these purposes is the most important at the Naval Academy. Research must provide the basis for a strong undergraduate program. Therefore, in addition to advancing the frontiers of their research areas, faculty members are committed to maintaining dynamic and challenging projects for midshipmen who choose to specialize in electrical engineering. Participating midshipmen

have the opportunity to engage, with faculty, in unstructured scientific effort of a wide variety; thus, they are exposed to some of the techniques applied to the solution of practical engineering problems. Research activity provides midshipmen the opportunity to learn how the engineering community responds to the ever-expanding needs of the service.

The Department of Electrical Engineering has continued to expand its capabilities for research and development efforts in both software and hardware of microprocessor systems. Support is now being received from the Naval Ship Research and Development Center (NSRDC), Naval Research Laboratory (NRL), and Naval Surface Weapons Center (NSWC). This support involves not only some hardware costs and intersessional faculty salaries, but the engineers at these Navy research and development centers are actively cooperating in finding areas in which small projects related to "real-world" problems can be effectively engineered by midshipmen in EE49X (Research Projects) courses and by Trident Scholars. This is a valuable experience for an undergraduate in any case. For the Navy and the prospective naval officer, the experience provides the benefits of producing junior officers who have not only had practical engineering experience but have an insight into the complex relationship between the Navy's own research and development community and the operating forces.

\*\*\*\*\*

SPONSORED RESEARCH

ELECTRICAL ENGINEERING DEPARTMENT

**THE DISTRIBUTION OF FREE ELECTRONS IN THE INNER GALAXY FROM  
PULSAR DISPERSION MEASURES**

**Researcher:** Assistant Professor David S. Harding

**Sponsor:** Naval Academy Research Council

The dispersion measures of a sample of 149 pulsars in the inner galaxy ( $|\ell| < 50^\circ$ ) were statistically analyzed to deduce the large-scale distribution of free thermal electrons in this region. A computer program employing Monte Carlo techniques was used for this analysis. The dispersion-measure distribution of these pulsars shows significant evidence for a decrease in the electron scale-height from a local value greater than the pulsar scale-height to a value less than the pulsar scale-height at galactocentric radii inside of  $\sim 7$  kpc. An increase in the electron density (to a value around  $.15 \text{ cm}^{-3}$  at 4-5 kpc) must accompany such a decrease in scale-height. There is also evidence for a large-scale warp in the electron distribution below the  $b = 0^\circ$  plane inside the solar circle. A model has been proposed for the electron distribution which incorporates these features; also, Monte Carlo-generated dispersion-measure distributions for parameters which best reproduce the observed pulsar distributions have been made. This research has been completed.

\*\*\*\*\*

**DEVELOPMENT OF SEMI-AUTOMATIC RADIATION TEST PROCEDURES FOR  
SUBMICRON NMOS**

**Researcher:** Associate Professor Richard L. Martin

**Sponsor:** Naval Research Laboratory

As submicron NMOS test units are developed using basic guidelines for processing variations, flexible semi-automatic radiation test procedures are required. The interface for a commercial data acquisition system with the NRL Co60 radiation facility has been implemented. A continuing effort is being made for software development for test and evaluation of a wide variety of test units.

\*\*\*\*\*

SPONSORED RESEARCH

ELECTRICAL ENGINEERING DEPARTMENT

**COMPUTER-AUGMENTED VIDEO EDUCATION (CAVE) DEVELOPMENT**

**Researcher:** Professor Ralph P. Santoro

**Sponsor:** Academic Computing Center, U.S. Naval Academy

Work on the CAVE system hardware and software continues. During the past year, the existing CAVE hardware and software were modified to allow utilization of the latest Sony 2000 series video tape player, the VP2011; this modification provides for increased tape-location control and concludes the refinement process for the tape-oriented CAVE system.

The next logical development for CAVE is the video disk, and during the past year a controller for use with the DVA PR-7820 and Pioneer VP-1000 players has been designed and its construction is nearly complete. Field trials of this video disk controller are expected to begin in early July 1982.

\*\*\*\*\*

**NON-DESTRUCTIVE PIPE CONDITION MONITORING**

**Researcher:** Associate Professor Antal A. Sarkady

**Sponsor:** Naval Ship Research and Development Center,  
Annapolis Laboratory

The goal of this research is to develop a portable instrument which can be used to monitor non-destructive flows in pipes. The last summer was dedicated for the design of a computer-based roster-scanner and data-logger.

This coming summer's efforts will be concentrated on the development of scanning and search type of ultrasonic detector to display the ultrasonic image.

\*\*\*\*\*

**ULTRASONIC TRANSDUCER TESTING**

**Researchers:** Associate Professors Antal A. Sarkady and Herbert M. Neustadt

**Sponsor:** Naval Research Laboratory

During the summer of 1981, work was done on an "Automated Transducer Tester." The following was accomplished:

1. A literature search on equivalent circuits for transducer and circuit parameter measurements was made.
2. Analog electronics were selected for the required parameter measurements. TTL circuits required for the computer control of measurements were chosen.
3. Compatibility of the control hardware and analog circuits with the Tektronix TM500 plug-in modules and associated bus structure was assured.

This summer (1982) work will continue on the project, including a working prototype of the model.

\*\*\*\*\*

**A COMPUTER-CONTROLLED AUTOMATIC CALIBRATION SYSTEM FOR ULTRASONIC TRANSDUCERS**

**Researchers:** Associate Professors Antal A. Sarkady, and  
Herbert M. Neustadt

**Sponsor:** Naval Research Laboratory

The end result of this project will be a computer-controlled system that automatically makes a sequence of measurements on ultrasonic transducers. The system will measure, record, plot, and analyze underwater directivity and impedance-versus-frequency curves for ultrasonic transducers.

During the summer of 1981, three computers, based on the TI9900, were built, and the procedure for making measurements was defined. During the summer of 1982, a complete system will be built, and in the following summer, the system will be evaluated by means of measurements made on many transducers.

\*\*\*\*\*

**RESEARCH COURSE PROJECTS**

**ELECTRICAL ENGINEERING DEPARTMENT**

**EPROM SIMULATOR FOR THE AIM-65**

**Researcher:** Midshipman 2/C Norbert H. Doerry

**Adviser:** Professor Ralph P. Santoro

An EPROM simulator-board has been designed and constructed for the AIM-65 development system. This board appears as RAM to the AIM-65 and EPROM to the external world, thereby providing an extremely valuable development tool.

This simulator-board has proven its value by successfully supporting three midshipman microprocessor-oriented design projects during the spring semester, 1982. It is estimated that the hardware and software "debug" phases were reduced by 75% by use of the simulator-board.

\*\*\*\*\*

**A SERIAL INTERFACE SYSTEM FOR THE AIM-65 MICROCOMPUTER**

**Researcher:** Midshipman 2/C Norbert H. Doerry

**Adviser:** Professor Ralph P. Santoro

An RS 232 board containing four independent bidirectional serial channels has been designed and constructed for use with the AIM-65 development system. Operating system software that permits the AIM-65 to communicate with NATS is 75% complete.

\*\*\*\*\*

**A SERIAL INTERFACE SYSTEM FOR THE KIM-1 MICROCOMPUTER**

**Researcher:** Midshipman 1/C B. L. Crutchfield

**Adviser:** Professor Ralph P. Santoro

An RS 232 board containing two independent bidirectional serial channels has been designed and constructed for use with the KIM-1 development system. Operating system software that permits the KIM-1 to communicate with NATS is 50% complete.

\*\*\*\*\*

DESIGN AND CONSTRUCTION OF A CONTROLLER-ORIENTED MICROCOMPUTER

Researcher: Midshipman 1/C Ralph T. Soule

Adviser: Professor Ralph P. Santoro

A very versatile single-board controller-oriented microcomputer has been designed and constructed. The design centers around the 6502 CPU and the 6522 I/O chips and features a real-time clock, cassette tape interface, and RS 232 serial I/O capabilities. The system monitor software utilizes pushbutton input and hexadecimal display but has been modularly designed so that expansion to include terminal I/O is readily accomplished.

\*\*\*\*\*



ALLEY, Reuben E., Jr., Professor, "Windmills," The Physics Teacher, 19 (December 1981), 590.

A common sight on the Western and European landscape from the fourteenth through the nineteenth centuries was the windmill. Although windmills were reported in the far and near East before 1000 A.D., practical applications began in England and northern Europe about 1200 A.D. Until the development of the steam engine, windmills and watermills were the only sources of energy other than humans and animals. This paper describes the development and construction of the various types of mills that were used for grinding grain and for pumping water. It includes a discussion of the experiments performed in 1759 by John Smeaton to investigate the most efficient design of windmill sails. The paper also included reproductions of several works of art, such as Rembrandt's The Mill, that show various windmill designs.

\*\*\*\*\*

HARDING, David S., Assistant Professor, co-author, "The Distribution of Free Electrons in the Inner Galaxy from Pulsar Dispersion Measures," Astrophysical Journal, 257 (June 1982), 603-611.

The dispersion-measures of a sample of 149 pulsars in the inner galaxy ( $|l| < 50^\circ$ ) were statistically analyzed to deduce the large-scale distribution of free thermal electrons in this region. A computer program employing Monte Carlo techniques was used for this analysis. The dispersion-measure distribution of these pulsars shows significant evidence for a decrease in the electron scale-height from a local value greater than the pulsar scale-height to a value less than the pulsar scale-height at galactocentric radii inside of  $\sim 7$  kpc. An increase in the electron density (to a value around  $.15 \text{ cm}^{-3}$  at 4-5 kpc) must accompany such a decrease in scale-height. There is also evidence for a large-scale warp in the electron distribution below the  $b = 0^\circ$  plane inside the solar circle. A model has been proposed for the electron distribution which incorporates these features; also, Monte Carlo-generated dispersion-measure distributions for parameters which best reproduce the observed pulsar distributions have been made.

\*\*\*\*\*

MARTIN, Richard L., Associate Professor, co-author, "Radiation Hardness on Submicron NMOS," IEEE Transactions of Nuclear Science, NS28 (December 1981) 6, pp. 4314, 4323, 4324.

Radiation hardness of submicron NMOS fabricated by electron-beam lithography was studied. It was found that, for radiation dosages below 10 Krads, the threshold shifts are not significant; also, there appears to be no channel-length dependence.

\*\*\*\*\*

PUBLICATIONS

ELECTRICAL ENGINEERING DEPARTMENT

SARKADY, Antal A., Associate Professor, co-author, "Measurement of Probability Density Functions Using a 16-Bit Microcomputer," IEEE 1981 IECT Proceedings, November 1981, pp. 129-134.

A 256-channel pulse-height analyzer was designed and developed, using a commercial single-board microcomputer. The analyzer is intended to be used for probability density-function computations of random and deterministic signals. The computer performs a multifunctional role of data acquisition, acquisition timing, data smoothing (filtering), and data display. The pulse-height spectrum (histogram) is continuously displayed on an X-Y oscilloscope by a foreground program which is interrupted for pulse-height data acquisition. A unique software-error filter is used to correct for the channel nonuniformity introduced by the analog-to-digital conversion.

\*\*\*\*\*



PRESENTATIONS

ELECTRICAL ENGINEERING DEPARTMENT

ALLEY, Reuben E., Jr., Professor, "Physics and Art," New England Section Meeting of American Association of Physics Teachers, October 1981.

\*\*\*\*\*

ALLEY, Reuben E., Jr., Professor, "Physics and Art: Some 20th Century Examples," Winter Meeting of the American Association of Physics Teachers, San Francisco, California, January 1982.

\*\*\*\*\*

ALLEY, Reuben E., Jr., Professor, "Physics and Art," Lecture at Southwest Texas Jr. College, Uvalde, Texas, March 1982.

\*\*\*\*\*

ALLEY, Reuben E., Jr., Professor, "Physics and Art," Physics Colloquium, Wellesley College, Wellesley, Massachusetts, March 1982.

\*\*\*\*\*

SARKADY, Antal A., Associate Professor, "Measurement of Probability Density Functions Using a 16-Bit Microcomputer," Industrial Electronics and Control Instrumentation Meeting, San Francisco, California, November 1981.

\*\*\*\*\*



## MECHANICAL ENGINEERING DEPARTMENT

*Professor Thomas W. Butler, Chairman*



Faculty and midshipmen research in the Mechanical Engineering Department covers many of the areas of specialization in mechanical engineering. These include research in direct energy conversion, combustion, fluid mechanics, heat transfer, solid mechanics, acoustics, dynamic effects, lubrication, corrosion, fracture mechanics, composite materials, welding, and design, and computer-aided graphics.

Research is supported mainly through funds from government agencies with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory, providing opportunities for several faculty members to work on projects during the

intersessional period. Additionally, some faculty members have undertaken independent research in their areas of expertise. Eleven civilian and 3 military faculty members have been active in the reported research of the Department this year which follows.

An important part of the Department's research effort each year is the involvement of midshipmen in independent research, design, and development projects. Current midshipmen interests include the Naval Academy Heat Balanced Engine, computer graphics, kinematics, combustion, heat transfer, rockets, mechanical testing, and many aspects of fluid mechanics.

Supporting the research effort in mechanical engineering are the extensive laboratory facilities located in Rickover Hall. The Department maintains facilities for performing experimental research in several areas: fluid mechanics, solid mechanics, materials science, experimental-stress analysis, control systems, mechanical vibrations, heat transfer, and thermodynamics.

The primary driving force behind the Department's research is the need for the faculty to stay abreast of developments in many diversified areas of mechanical engineering, thereby enabling them to be more effective classroom teachers.

\*\*\*\*\*

**LIGHT WEIGHT ARMOR MATERIALS TESTING**

**Researcher:** Professor Thomas W. Butler

**Sponsor:** Naval Surface Weapons Center, White Oak Laboratory

This project involves development of innovative testing techniques for armor candidate materials. Slow-bend instrumented tests were performed on five candidate materials and the results presented at a conference.

\*\*\*\*\*

**MAIN REDUCTION GEARING**

**Researcher:** Associate Professor Elliott E. Dodson

**Sponsor:** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The objective of this report is to summarize current reduction gear state-of-the-art, design, theoretical analysis, test data and usage information for possible application to advanced submarines.

It is intended that this report provide a background in main reduction gearing with emphasis placed upon current thinking and practice, particularly in regard to Naval applications and demands for compactness, higher loading, and power density and, less noise.

Such demands, as stated in the previous paragraph, pose a difficult design problem for industry in this country, since most very large gears are designed conservatively to allow for a lack of precise design data. Additionally, there is a need to improve manufacturing techniques and facilities, particularly in the area of surface hardened gears. U. S. manufacturers do not presently build surface-hardened and ground gears in the sizes required for second reduction gears of submarines and larger surface vessels.

The report contains an extensive bibliography, consisting of a set of first pages from eighty-nine technical papers, the results of a literature search conducted by the DTNSRDC library, and seventy-three selected technical papers deemed to be of particular interest. These have been arranged in reference files. All material is unclassified.

\*\*\*\*\*

## INVESTIGATION OF VORTEX/CONTROL FIN INTERACTIONS

Researcher: Associate Professor Joseph D. Gillerlain, Jr.

Sponsors: Naval Surface Weapons Center, White Oak Laboratory, and Naval Air Systems Command

The objective of this investigation is to develop predictive methods for the aerodynamic behavior of missiles and aircraft experiencing vortex impingement on control surfaces. Detailed knowledge of the three-dimensional viscous flow field, as determined from wind-tunnel experiments, is required in order to model the vortex-fin interaction and to develop predictive methods.

The experimental measurements will be made in the U. S. Naval Academy Aerodynamics Laboratory subsonic wind-tunnel. A pressure distribution model, consisting of a rectangular fin with a cylindrical leading edge, has been built. The fin is adjustable for angle-of-attack.

Non-intrusive flow measurement and flow visualization techniques will be used, to include three-dimensional laser Doppler velocimetry (LDV) and the fluorescent mini-tuft method, respectively. The pressure distribution data will be integrated to obtain aerodynamic forces, which will be compared with force balance data. Results of various conventional methods of wing/fin analysis will be compared to the measured aerodynamic loads.

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## THREE-DIMENSIONAL LASER DOPPLER SYSTEMS IN WATER

Researcher: Professor Robert A. Granger

Sponsor: Naval Coastal Systems Center, Panama City, Florida

A preliminary study for a design of a laser Doppler velocimeter (LDV) to measure these components of velocity simultaneously in water has been performed. The design is particularly suitable to the U. S. Naval Academy's high performance tow tank and its recirculating water channel. Methods are given to calculate the essential parameters for operating the LDV system with extreme accuracy. Features and descriptions are given of the components of the LDV system, and layouts are presented that will enable velocity measurements to be made without difficulty. A special LDV system is proposed for measuring velocity components near a large amplitude unsteady towed submersible. This system utilizes diode laser technology. A final report was issued and delivered according to a distribution list.

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**PIG-TAILED TOWED SUBMERSIBLE**

Researcher: Professor Robert A. Granger

Sponsor: Naval Coastal Systems Center, Panama City, Florida

Funds were provided to the U. S. Naval Academy by NCSC to perform an experimental measurement of the motions of a towed submersible vehicle resulting from external excitation of surge and heave. In particular, the Academy was to construct a half-scale model of a NCSC vehicle, the towing device to tow the vehicle at a depth of 10 feet in the USNA High Performance Tow Tank, and the vertical and horizontal excitation apparatus to simulate heave and surge displacements up to  $\pm 1.0$  feet with variable frequencies. Ratio of pitch, roll, and yaws, plus longitudinal motions and depth fluctuations are to be measured for assorted frequencies and amplitudes of heave and surge, assorted tow speeds up to 14 knots, various tow lengths, assorted gin geometries, and varied vehicle longitudinal c.g./c.b.

All designs and constructions are complete. As this project is the first dynamic experimental program run in the USNA Tow Tank, all set-up, tear down, and operational procedures had to be developed while conducting experiments. Stability analysis of the vehicle is being conducted. Progress is satisfactory, with results of measurements usually bringing new studies to be performed. The project is inexhaustible.

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**ROTARY HYDRODYNAMIC COEFFICIENTS FOR UNDERWATER VEHICLES**

Researcher: Professor Robert A. Granger

Sponsor: Naval Coastal Systems Center, Panama City, Florida

Funds were provided to the U. S. Naval Academy to perform an analysis of the forces and moments on an arbitrary vehicle undergoing constant angular velocity motion at arbitrary angles-of-attack and side-slip. The analysis is constrained for bodies in curved flow and in rolling flow. A theory was developed to predict the hydrodynamic forces of moments and is based on the premise that if two flows under the influence of bodies immersed in them experience the same geometrical distortion of lines of flow, the forces acting on the bodies might be regarded as approximately equal.

To test this theory, a methodology was formulated for high speed computation. To conserve time, the panel method of F.A.

SPONSORED RESEARCH

MECHANICAL ENGINEERING DEPARTMENT

Woodward was utilized. Work is progressing on modifying the Woodward program to make it suitable for low speed studies and for curved bodies. When the program is operational, a streamlined body of revolution, representing a submarine moving in a fixed radius of turn, will be applied. The results will be compared against experimental measurements.

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**CORROSION FATIGUE OF SiC/Al METAL MATRIX COMPOSITE MATERIALS**

Researcher: Associate Professor Dennis F. Hasson

Sponsors: Naval Surface Weapons Center, White Oak Laboratory, and Naval Air Systems Command

A study to understand the corrosion fatigue behavior of SiC/Al metal matrix composite materials. Fatigue testing in salt-laden moist air is performed. Metallography and scanning electron microscope fractography is also performed to determine fracture mechanisms. Reports and papers are prepared on the results.

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**TEMPER EMBRITTLEMENT OF HY100 CASTINGS**

Researcher: Associate Professor Dennis F. Hasson

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

This study prepared a test matrix, evaluated data and prepared status and final reports on the results. It also performed metallographic and fractographic analyses to provide an analysis of temper embrittlement on HY100 steel castings.

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**DYNAMIC FRACTURE TOUGHNESS OF HY STEELS AND Ti-100**

Researcher: Associate Professor James A. Joyce

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

Fracture toughness of HY steels and Ti-100 under dynamic loading conditions in terms of elastic-plastic fracture mechanics (EPFM) characterization parameters was evaluated as well as the role of loading rate on fracture toughness levels and fracture toughness/temperature transition behavior of these alloys. In addition, the

applicability of  $J_{Ic}$ , T and other elastic-plastic characterization parameters under loading conditions ranging from static ( $10^{-4}$  in/in/sec) to explosive impact ( $10^4$  in/in/sec) strain rate regimes was evaluated.

Test methods were developed to evaluate  $J_{Ic}$  and the  $J_I$ -R curve under dynamic loading rates ( $J > 10^5$  in-lb/in<sup>2</sup> sec) and under impact loading rates using HY steels and Ti-100. The researchers evaluated the fracture toughness of HY steels and Ti-100 using  $J_{Ic}$ , T and possibly other EPFM characterization parameters at ambient and cryogenic temperatures for static and dynamic elastic-plastic fracture toughness properties of HY steel and Ti-100.

$J_I$ -R curves have been developed for HY-130 at ambient temperatures using the highest loading rates available in fast acting hydraulic testing machines (about 1 in/in/sec strain rate) and conventional instrumentation. Parameters  $J_I$ -C and T measured were comparable to statically determined toughness and crack growth resistance. Contracts have been let for modification of an hydraulic testing machine with a high-performance system for high loading-rates and for a multi-channel fast data acquisition package. An assessment of dynamic crack extension measurement methods is in progress. Specimen preparation for the test method phase of the study was completed.

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#### INSTABILITY TESTING OF NUCLEAR GRADE PIPE

Researcher: Associate Professor James A. Joyce

Sponsors: Nuclear Regulator Commission, and  
David W. Taylor Naval Ship Research and Development  
Center, Annapolis Laboratory

The research developed a test procedure to evaluate experimentally the tearing instability conditions for circumferentially cracked 8" diameter A106 pipe at room temperature loaded in 4 point bending in a compliant test machine. Presently fixtures are being prepared in David W. Taylor Naval Ship Research and Development Center shop to accomplish this task. Pipe has been purchased and characterized using small specimens. The test machine was upgraded for fatigue and test under computer control.

Recently both stable and unstable tests have been completed, including one test alone expressly for Nuclear Regulatory

Commission observers. The program is nearing completion after two more unstable tests to be done for cameras and preparation of a film describing all work completed.

\*\*\*\*\*

GAS TABLES 1,4,7 PROGRAMMED FOR HP-67 WITH BRIEF REVIEW OF COMBUSTION

Researcher: Professor Vincent J. Lopardo

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The primary objective of this work was to adapt a NASA program for calculating enthalpies and entropy functions for air and products of combustion for usage on an HP-67 programmable calculator. The major problem with the HP-67 is the limited number of storage registers and programmable steps. This was overcome by truncating some of the polynomial coefficients and accepting a difference of about 0.1 to 0.5 in the enthalpy values. No adjustments were made with the entropy function.

A secondary, and possibly as important an aspect of this study, was to review the combustion process as usually encountered in mechanical engineering. The concept of the common reference datum is addressed and a method for computing the enthalpy for the products of combustion is developed. The development follows the technique suggested by Keenan and Kaye in the Gas Tables. The enthalpies and entropy functions can thereby be evaluated for the products of a hydrocarbon fuel for any fuel-air ratio.

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A COMPARISON OF GAS TURBINE PERFORMANCE USING THE EXERGY METHOD OF ANALYSIS

Researcher: Professor Vincent J. Lopardo

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The purpose of this study was to evaluate the performance of several types of gas turbines using a second law analysis. Two different turbines were evaluated. They were compared for conditions of "without regenerator" and "with regenerator" using two different techniques. The first employed the use of the JANAF tables with  $C_{10}H_{22}$  as the fuel and the second used the GAS TABLES (see EW-9-81) for a fuel with a lower heating value of 18,400 Btu/lbm. The primary exergy losses occur, in all cases, in the combustion process and in the exhaust stream.

\*\*\*\*\*

**IMPACT CHARACTERISTICS OF BOXING GLOVES WITH VARIOUS FILLERS**

Researcher: Associate Professor Jack H. Smith

Sponsor: Naval Academy Research Council

Little research has been done on the impact characteristics of different fillers for boxing gloves used in professional and intercollegiate boxing. Associate Professor Emerson Smith, Physical Education Department, has been actively interested in decreasing the number of injuries in boxing for years. His suggestions to the Everlast Company, makers of boxing equipment, have improved the safety quality of gloves and headgear.

He has obtained ten boxing gloves (10 oz) from Everlast with ten different fillers or filler combinations. The fillers are as follows:

1. 1/2" latex & hair
2. 1/2" latex & polyfiber
3. 1/2" latex & 3/4" PVC foam
4. 3/8" PVC foam & hair
5. 3/8" PVC foam & polyfiber
6. polyfiber only
7. 1" polyfoam & polyfiber
8. 1" polyfoam & hair
9. 1/4" latex 1" polyfoam & hair
10. 1/4" latex, 3/4" PVC foam & hair

The purpose of this research will be to determine the difference in impact characteristics of the above ten filler combinations and include additional filler combinations should the initial investigation so warrant. The end result is finding a specification for filler material to minimize injury in inter-collegiate boxing.

\*\*\*\*\*

A NUMERICAL METHOD FOR THE CALCULATION OF LUBRICANT PRESSURES IN BEARINGS WITH MIXED LUBRICATION

Researcher: Lieutenant Commander Michael E. Weyler, CEC, USN

Sponsor: Naval Academy Research Council

When the lubricant film which separates the surfaces of a lubricated contact or bearing becomes thin enough, the surface asperities, or roughness, that are present on all engineering surfaces begin to interfere. This region of surface interference is called the region of mixed lubrication. A simple approach to predicting behavior in the mixed lubrication region is to assume that the total load applied normally to the plane of the lubricated surfaces is carried partly by the hydrodynamic action of the lubrication film, and partly by asperity contacts. In the same fashion, the total friction force between the lubricated surfaces is taken to be partly due to viscous friction and partly due to asperity contacts.

In recent years Christensen, Berthe and Godet proposed mixed lubrication theories, based on this model and the use of the Reynolds' Equations for incompressible fluid flow. Wu added to the theory by proposing a truncated normal distribution for the surface roughness, thereby allowing application of the theory to actual contacting surfaces with measurable roughness. The objectives of this research are to develop equations for the determination of lubricant pressures in mixed lubrication using the Wu model, and to develop a simple numerical method for calculating the lubricant pressures in such a bearing.

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## DYNAMIC KEY WAVE TESTING METHOD DEVELOPMENT

Researcher: Associate Professor James A. Joyce

This research was to continue development of methods to obtain dynamic J-R curves at loading rates of 100 in/sec using the key-curve method or the potential-drop method and to study further the tearing instability phenomena to determine the conditions for instability arrest for compact specimens loaded in compliant systems with and without inertia properties.

Data is obtained from drop weight tests: digital load, load point displacement, time records for 1T and 1/2T bend bar specimens and then utilizing the previously developed key curve analysis to obtain applied J- $\Delta a$  R curves at test rates of 100 in/sec. The material used will be HY130 steel. Additional tests will be conducted, utilizing the potential drop methodology to measure crack length directly. This method has shown great promise for static tests but has not been applied at high rates of loading. Compact specimens will be loaded in a compliant test machine as done previously but high rate load-point displacement data will be taken during the instability. The data will allow determination of the energy absorbed by the specimen during the instability and will allow evaluation of  $T_{MAT}$  at the instability arrest point. Application of various system inertia properties will allow evaluation of the effect of test system inertia and ultimately structure inertia on the instability arrest conditions.

Major delays have occurred in getting the drop weight tower in place. Additional problems have developed in obtaining adequate frequency response transducers to measure load point displacement at the 100 in/sec loading rate. These problems have now been overcome and tests on 1/2T and 1T HY130 bend bar specimens are being completed. A Fourier series technique has been developed to smooth the resulting load and load point displacement versus time curves for utilization in the key curve analysis method.

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**RESEARCH COURSE PROJECTS**

**MECHANICAL ENGINEERING DEPARTMENT**

**SURGING RESPONSES OF A TOWED VEHICLE**

**Researcher:** Midshipman 1/C Stephen A. Burris

**Adviser:** Professor Robert A. Granger

This project is an aspect of research stemming from the Pig-Tail Towed submersible project. The researcher investigated certain criteria of instability in towing a streamlined submersible for solely horizontal excitation.

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**KINEMATIC ANIMATIONS FOR DYNAMIC ANALYSIS**

**Researcher:** Midshipman 1/C James K. Byrd

**Adviser:** Professor James A. Adams

The research involved creating software on the PDP-11 using RT-11 FORTRAN, which demonstrated the kinematics of various Four-bar linkages and displayed these graphically on a Tektronix terminal as well as the Picture System. Adapting the software to the Picture System made it possible to create actual animation showing the motion of the linkage. This was made possible by the Picture System's refresh capability. This software utilized the technique of Newton-Raphson iteration, and much of the software was adapted from some already existing in BASIC on the Naval Academy Timesharing System. This project can aid in the continuing work in animation and can possibly be used for classroom demonstrations.

\*\*\*\*\*

**HEAT FLUX AND BOUNDARY FLOW OVER A WAVY WALL**

**Researcher:** Midshipman 1/C Thomas Cosgrove

**Adviser:** Professor Robert A. Granger

Boundary layer flow past a wavy wall of small amplitude and low frequency with fixed temperature distributions has been examined experimentally in the USNA recirculating water tunnel. The velocity measurements are made with a laser Doppler velocimeter for a range of free-stream velocities. The research was exploratory, and has as its goals to identify the character of the water channel test section, the application of the LDV system to the water channel, and experiment procedure for measurements.

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**XPCL FUEL ADDITIVE ENERGY EVALUATION**

Researcher: Midshipman 1/C Bruce W. Dudley

Adviser: Associate Professor Eugene L. Keating

An extensive combustion analysis of the XPCL fuel additive, purchased by the Navy, will be made. This material, which has proposed applications in diesel engines and marine boilers, will be studied in various experiments. Bomb calorimetry and distillation curves will be made to determine the energy characteristics of the material. To assess the proposed characteristics of this material to clean fire brick and steam generation tubes in a boiler, a continuous combustion rig will be operated using a blend of fuel oil #2 and XPCL. An energy balance and stuck analysis of the combination of XPCL and fuel oil will then be made.

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**ANEROBIC DIGESTER DESIGN - USNA**

Researcher: Midshipman 1/C David A. Dunaway

Adviser: Associate Professor Eugene L. Keating

An anaerobic digestion system will be designed and built to use scrap nutrients supplied by the U. S. Naval Academy Galley. A study of feasible anaerobic digestion processes will be made. A preliminary small scale pilot plant will then be made and design analysis of a full scale digester will be completed in order to assess the potential methane generation at the U. S. Naval Academy Galley.

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**TRANSIENT TEMPERATURE MEASUREMENTS IN A FIN**

Researcher: Midshipman 1/C John Foley

Adviser: Professor John O. Geremia

Temperature profiles were obtained for unsteady-state heat transfer on the edge of a fin. The profiles were corrected for time lag in temperature measurement. Corrected temperatures were used to calculate unsteady state parameters and compare them with published values.

\*\*\*\*\*

BURMESTER CURVES AND COMPUTER-AIDED DESIGN

Researchers: Midshipmen 1/C James H. Fowles III and  
John G. Spear

Adviser: Professor James A. Adams

Software was written to allow interactive computer-aided synthesis of planar linkages. To use this software package the user must specify the type of motion required of the output member. The computer then calculates all possible 4-bar linkage configurations which allow either a crank-rocker or crank-crank type of operation. In addition, the complete circle point-centerpoint curves (Burmester) are drawn on a storage tube display. The user then makes a choice from the possible solutions and uses another program to perform a kinematic analysis of the mechanism. This second program produces kinematic motion curves of displacement, velocity, and acceleration. The process of synthesis and analysis can be repeated in an interactive manner until a suitable design is found. All programs are run on the USNA Time Sharing System using the H6060 mainframe. They provide a computer-aided capability for planar linkages.

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LIQUID PROPELLANT ROCKET PROPULSION SYSTEM

Researcher: Midshipman 2/C Benito Loyola

Adviser: Associate Professor James A. Joyce

The aim is to design and construct a liquid propellant rocket engine through the use of computer design techniques.

The rocket nozzle will be designed by using the method of characteristics and will be constructed on a computerized milling machine. This will result in a high performance rocket engine.

A static test stand will be designed and constructed for later testing of rocket engine performance.

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## INVESTIGATION OF MARINE PROPULSION TURBINE CHARACTERISTICS

Researcher: Midshipman 1/C Russell H. Smith

Adviser: Lieutenant Commander Richard H. Funke, USN

The Rickover Hall steam plant steam turbine has never been extensively tested to determine its performance characteristics at different speeds. This research project is intended to:

(1) Gather data at speeds from 500 to 5000 RPM and various torque settings from the HP turbine. With the steam tables in the computer, the data will be reduced by computer program to provide the following performance parameters: internal horsepower, internal efficiency, brake horsepower, brake engine efficiency, mechanical efficiency, brake steam rate, rate throttle loss and exit loss, and

(2) Determine torque-speed variation to simulate marine propulsion,

(3) Attempt to test unit under such conditions to simulate marine propulsion,

(4) Recommend improvements to installed instrumentation.

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DODSON, Elliott E., Associate Professor, "Main Reduction Gearing,"  
David Taylor Naval Ship Research & Development Center  
Report, August 1981.

The objective of this report is to summarize current reduction gear state-of-the-art, design theoretical analysis, test data, and usage information for possible application to advanced submarines.

It is intended that this report provide a background in main reduction gearing with emphasis placed upon current thinking and practice, particularly in regard to Naval applications and demands for compactness, higher loading and power density, and less noise.

Such demands, as stated in the previous paragraph, pose a difficult design problem for industry in this country, since most very large gears are designed conservatively to allow for a lack of precise design data. Additionally, there is a need to improve manufacturing techniques and facilities, particularly in the area of surface-hardened gears. U. S. manufacturers do not presently build surface-hardened and ground gears in the sizes required for second reduction gears of submarines and larger surface vessels.

The report contains an extensive bibliography consisting of a set of first pages from eighty-nine technical papers, the results of a literature search conducted by the DTNSRDC library and seventy-three selected technical papers deemed to be of particular interest. These have been arranged in reference files. All material is unclassified.

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GEREMIA, John O., Professor, "Experimental Designs for Cable Flammability Tests," Naval Ship Research and Development Center Report, September 1981.

The report outlines and then details the procedure to be followed when running flammability tests on electrical cables. There are four independent variables and three dependent variables. The test strategy allows for a complete analysis with 27 carefully chosen runs.

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GEREMIA, John O., Professor, "Analysis of Corrosion Data," Naval Ship Research and Development Center Report.

Corrosion data for four different alloys, used on turbines, was acquired in accordance with the strategy laid out in author's report, "Design of Experiments for Corrosion Tests," 1981. The analysis showed a severe temperature/alloy interaction; at low temperature an alloy would perform poorly, while at high temperature it performed well. Some alloys displayed the reverse behavior, doing well at low and poorly at high temperature.

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GILLERLAIN, Joseph D. Jr., Associate Professor, "Vortex Impingement on a Control Fin," co-author, AIAA Paper No. 82-0171, AIAA 20th Aerospace Sciences Meeting, January 1982.

Accurate prediction of the aerodynamic behavior of missiles and aircraft experiencing vortex impingement on control surfaces becomes more essential as high angle-of-attack maneuvering requirements increase. Detailed knowledge of the three-dimensional (3-D) viscous flowfield, as determined from wind-tunnel experiments, is required in order to develop predictive methods based on the vortex/fin interaction. Subsonic windtunnel tests were conducted using a rectangular fin model adjustable for angle-of-attack with an impinging vortex generated upstream of the fin. Force, moment, and pressure distribution data were obtained for one freestream velocity and one vortex strength. Flow visualization tests utilized a fluorescent mini-tuft technique. The 3-D flowfield was surveyed, using a laser Doppler velocimeter (LDV). Experimental results are presented.

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GILLERLAIN, Joseph D. Jr., Associate Professor, "Vortex/Control Fin Interactions," co-author, AIAA Paper No. 82-0950, AIAA/ASME, 3rd Joint Thermophysics Fluids Plasma and Heat Transfer Conference, June 1982.

Accurate prediction of the aerodynamic behavior of missiles and aircraft experiencing vortex impingement on control surfaces becomes more essential as high angle-of-attack maneuvering requirements increase. Detailed knowledge of the three-dimensional (3-D) viscous flowfield, as determined from wind-tunnel experiments, is required in order to develop predictive methods based on the vortex/fin interaction. Subsonic wind-tunnel tests were conducted using a rectangular fin model adjustable for angle-of-attack with an impinging vortex generated upstream of the fin. Force, moment,

and pressure distribution data were obtained for one freestream velocity and one vortex strength. Flow visualization tests utilized a fluorescent mini-tuft technique. The 3-D flowfield was surveyed using a laser Doppler velocimeter (LDV). Further experimental results are presented.

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GRANGER, Robert A., Professor, "On a Geophysical Inviscid Vortex," Quarterly of Applied Mathematics, July 1982.

An inviscid vortex rotating in a stratified environment is investigated. The equations of linear momentum are developed in combination with the conservation of energy, assuming the centerline vorticity and temperatures are functions of altitude. The experimental results of Granger were used for the centerline vorticity distribution. The type of geophysical vortex treated is dictated by the type of distribution one uses to describe the potential temperatures, and this is largely governed by the range in altitude one wishes to consider. For certain weak strength dust-devils, one might be interested in elevations less than 19 km, such that the lapse rate is greater than adiabatic. For tornados, the altitude might extend to 20 km, such that the lapse rate is less than adiabatic. Also treated is the neutral stability case. Closed Form analytic solutions are obtained using similarity transformations.

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HASSON, Dennis F., Associate Professor, and James A. JOYCE, Associate Professor, "The Effect of a Higher Loading Rate on  $J_{Ic}$  Fracture Toughness Transition Temperature of HY Steels," Journal of Engineering Materials and Technology, 103 (April 1981), 133-141.

The objectives of the study were to extend the  $J_{Ic}$  transition temperature analysis of earlier work for HY130 to HY80 steel and also to determine the effect of a higher strain rate on the  $J_{Ic}$  fracture toughness of both HY80 and HY130 steels. The fracture parameter  $J_{Ic}$  in both low and high strain rate tests demonstrated a ductile-to-brittle transition in HY80 and HY130 steels analogous to Charpy V notch transition behavior. The  $J_{Ic}$  transition temperature from slow rate tests was less conservative than that from fast rate tests. The  $J_{Ic}$  transition temperatures from slow and fast rate tests gave less conservative transition temperatures than those from Charpy tests. SEM stereo pair fractography showed that the transition from ductile to brittle behavior was not as gradual for the fast rate testing as previously reported for slow rate tests.

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PUBLICATIONS

MECHANICAL ENGINEERING DEPARTMENT

HASSON, Dennis F., Associate Professor, "Titanium for Offshore Oil Drilling," co-author, Journal of Metals, 34 (January 1982), 23-28; reprinted in Titanium for Energy and Industrial Applications. Warrendale, Pennsylvania: Technology of Metallurgy Series, The Metallurgical Society of AIME, 1981, pp. 65-82.

Current and future applications for titanium and its alloys for offshore drilling have been examined. Successful applications were shown for heat exchangers, valves, pumps, and chlorination systems. Future applications, especially for deep-water drilling, marine risers, pre-stressed riser connectors, fixtures, and fittings, were shown to be excellent possibilities. The cost of titanium was indicated to be reduced and in some cases more than competitive, especially in terms of maintenance reduction and improved operation. Since titanium and its alloys are excellent materials for offshore oil drilling operations, it is suggested that the titanium industry be alerted to demands in order to ensure timely availability.

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HASSON, Dennis F., Associate Professor, "The Use of Titanium in Deep Sea Exploration," co-author, Titanium for Energy and Industrial Applications, Warrendale, Pennsylvania: Technology of Metallurgy Series, The Metallurgical Society of AIME, 1981, pp. 93-119.

The use of titanium alloys in deep sea exploration applications is reviewed. Material properties are summarized and related to design considerations to illustrate the favorable characteristics of titanium alloys for deep sea submersible pressure hull and ancillary equipment application. Although current use of titanium in deep submersible applications is limited, future use is expected to increase as the need for greater operational depth increases.

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JOYCE, James A., Associate Professor, co-author, "Tentative Test Procedure for Determining the Plane Strain J<sub>I</sub>-R Curve," Journal for Testing and Evaluation, American Society for Testing and Materials (December 1981).

A tentative test procedure for the determination of the plane strain J<sub>I</sub>-R curve for metallic materials is presented. This procedure was prepared by a Working Group of ASTM Committee E24.08.03. It was evaluated with a round-robin test program on HY130 steel conducted in 1980-1981. The results of the testing program were reported in a companion paper and incorporated in this procedure. The procedure is written for the elastic compliance method of developing the plane-strain J<sub>I</sub>-R curve. Recommended specimens are the pin-loaded compact and the 3-point bend specimens. Details regarding apparatus, specimen preparation, test system calibration, testing, calculation of J and crack extension, and data qualification are specified.

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JOYCE, James A., Associate Professor, co-author, "An Experimental Evaluation of Tearing Instability Using the Compact Specimen," American Society for Testing and Materials, Special Technical Publication 743 (1981), 525-542.

The objective of this investigation was to produce experimental verification of the tearing instability theory proposed by Paris and co-workers. This theory states that ductile crack extension will occur in an unstable fashion whenever the applied tearing force is greater than the material tearing resistance. In this investigation a series of compact specimens of aluminum, titanium, and steel alloys was tested in a variably compliant

test machine to generate a range of applied tearing force. The material tearing resistance was measured from the  $J_I$ -R curves of the stable specimens and compared with the applied tearing force necessary to generate ductile tearing instability in each material. The Paris theory was found to accurately predict the onset of gross instability behavior. Some limited instability behavior was found, however, at values of tearing force less than the average material tearing resistance obtained from an unloading compliance  $J_I$ -R curve test. Limited instability behavior was characterized by repeated short steps of rapid but ductile crack extension, separated by regions of slow stable tearing.

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JOYCE, James A., Associate Professor, co-author, "Dynamic  $J_I$ -R Curve Testing of HY-130 Steel," Naval Sea Systems Command Sea (05R1S) Report, SME-81/57, October 1981.

The  $J$ -integral crack growth resistance properties of HY-130 steel were developed under dynamic loading conditions. The objective of this program was to extend the key-curve method to evaluate ductile fracture properties of HY-130 steel compact specimens where the loading rate produced a load-line crack-opening displacement rate on the order of 9-inches per second. A key curve for HY-130 plate was developed under dynamic loading conditions using subsized specimens and was applied to tests of LTCT Specimens. Results of ambient temperature tests showed that both  $J_{IC}$  and the tearing modulus of this steel were substantially elevated under dynamic loading. The fracture process of specimens tested under dynamic and static loading conditions was found to be similar and completely ductile.

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LOPARDO, Vincent J., Professor, "Gas Tables 1,4,7 Programmed for HP-67 with Brief Review of Combustion," Division of Engineering and Weapons Report EW-9-81, September 1981.

The primary objective of this work was to adapt a NASA program for calculating enthalpies and entropy functions for air and products of combustion for usage on an HP-67 programmable calculator. The major problem with the HP-67 is the limited number of storage registers and programmable steps. This was overcome by truncating some of the polynomial coefficients and accepting a difference of about 0.1 to 0.5 in the enthalpy values. No adjustments were made with the entropy function.

A secondary, and possibly as important an aspect of this study, was to review the combustion process as usually encountered in mechanical engineering. The concept of the common reference datum is addressed and a method for computing the enthalpy for the products of combustion is developed. The development follows the technique suggested by Keenan and Kaye in the Gas Tables. The enthalpies and entropy functions can thereby be evaluated for the products of a hydrocarbon fuel for any fuel-air ratio.

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LOPARDO, Vincent J., Professor, "A Treatise on Exergy and Second Law of Thermodynamics," Division of Engineering and Weapons Report EW-2-82, February 1982.

The purpose of this report is to introduce the reader to the concept of exergy via the previously learned concepts of reversibility and the second law of thermodynamics. Exergy is first defined in general and then evaluated for energies of flowing streams, closed systems, heat transfer, and work transfer. Some applications are given and then a review with application of combustion principles and the third law of thermodynamics follows. The paper concludes with some comments on the exergetic effectiveness of systems.

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MACKNEY, Michael D. A., Lieutenant Commander, Royal Navy, co-author, "Axisymmetric Deformation of Thin-Walled Domes Under Uniform Pressure," Stress Analysis of Fabricated Structures and Components. London: Stress Analysis Group, Institute of Physics, October 1981.

An axisymmetric constant meridional curvature (ACMC) finite element is developed using a cubic Hermitian polynomial as the out-of-plane displacement function for the axisymmetric analysis of thin shells. The ACMC element is assigned for structures with curved meridians; either with a positive meridional curvature representing closed form structures, or those with negative meridional curvatures representing open form structures, such as cooling towers. The element validated against structures including flat plates, cones, cylinders, cooling towers, and spherical caps, gave accurate results with rapid convergence and stable computation.

A theoretical analysis was carried out on a series of oblate and prolate hemispheroid shells under hydrostatic and hydrodynamic loading conditions, with a limited experimental study.

All the shells failed by instability, oblate hemispheroids failing by an axisymmetric mode and the hemispheroid and prolate hemispheroids failing by lobar buckling in their flanks.

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MACKNEY, Michael D. A., Lieutenant Commander, Royal Navy, co-author, "Instability of Oblate and Prolate Hemispheroidal Domes Under Uniform Pressure," Stress Analysis of Fabricated Structures and Components. London: Stress Analysis Group, Institute of Physics, October 1981.

A number of cast solid urethane plastic thin-walled shells were subjected to external hydraulic pressure in a test tank and tested to failure. All the domes failed through elastic instability: the oblate shapes failing axisymmetrically and the prolate shapes failing by lobar buckling.

An analysis was carried out using the finite element method applied to axisymmetric and asymmetric instability. The experimental buckling pressures showed consistency and the comparison between experiment and theory was found to be good.

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MACKNEY, Michael D. A., Lieutenant Commander, Royal Navy, co-author, "Mini-Computer Based Data Acquisition and Control Software for the Experimental Evaluation of Structures," Advances in Engineering Software, 4 (April 1982), 46-51.

Major studies to establish the factors which influence the design of thin shell structures for maritime use, resulted in the development of a structural testing facility. Full size or scale models of structures were tested and examined under simulated hydrodynamic loading, using a multi-channel pressure loading system, and a data acquisition system. Since few staff can be employed to carry out the many functions necessary, much automation of loading and data collection is required.

The software which is used to control the loading and data acquisition forms a very important part of the structural testing facility, with a major consideration being that the facility should be used by engineers who do not have to be very familiar with computing, and need no programming knowledge.

The programs are easy to run and use, and are written in a conversational manner. Since large amounts of data are collected, the observed and reduced data, and the processed results, together with graphs and other pertinent information, are presented in a standard report format. A number of inter-related programs, sharing a common data base, allow calibrations to be made when preparing for a test, carry out the test, process the information, and produce the technical report.

The whole software package was developed in less than a year by one programmer/analyst and demonstrates how a mini-computer system can become a powerful and flexible tool for engineering research, controlling simulation and data acquisition at low cost without the need for more expensive and less adaptable brought-in software.

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McKNIGHT, Thomas N. Jr., Captain, USAF, "Turbulent Shear Flow Velocity Profiles Behind a Grid of Parallel Rods of Variable Spacing," Air University, Maxwell Air Force Base, Alabama, Research Report, 25 (1981), 1-85.

An experimental study was conducted to investigate the turbulent shear flow velocity profiles generated by a parallel rod grid with adjustable spacing designed to produce an artificial boundary layer. The study was conducted in a low turbulence wind tunnel with a 9 x 9 x 37-inch test cabin. Data was collected using a hot-wire anemometer in conjunction with a correlator. The turbulence parameters reported are the development and distribution of mean velocities, fluctuating velocities, Reynolds stresses, microscales, and integral scales at 32, 112, and 232 rod diameters downstream of the grid. Results show that stable power-law velocity profiles can be generated with negligible diffusion of the shear layer along the length of the test cabin. Turbulence intensity plots show that 75% of the grid-generated turbulence decayed within 100 rod diameters downstream from the grid. The microscale and integral scales showed their minimum values close to the grid and increased in value downstream. Also, the ratio of the spatial integral scale to the spatial microscale was approximately 3.0 throughout the test cabin.

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WEYLER, Michael E., Lieutenant Commander, USN, and Chih Wu, Professor, co-authors, "A Numerical Method for the Calculation of Lubricant Pressures in Bearings with Mixed Lubrication," Tribology International, 15 (April 1982), 89-95.

A model for mixed lubrication, assuming that the total normal load applied to the plane of the lubricated surfaces is carried partly by the hydrodynamic action of the lubrication film and partly by asperity contacts and that the total friction force between the lubricated surfaces is partly due to viscous friction and partly to asperity contacts, was used to develop a numerical solution for pressure distribution in a bearing experiencing mixed lubrication. The geometry treated and the pressure distribution obtained were for a simple slider bearing, but the method could easily be extended to other shapes. The model is based on measured roughness of a real surface. Real load carrying capacity and drag can therefore be determined since they are related directly to bearing pressure distribution.

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WU, Chih, Professor, "A Numerical Method for Mixed Lubrication," (Book edited by E. Hinton, P. Bettess and R. W. Lewis) Numerical Methods for Coupled Problems. Swansea, U.K.: Pinteridge Press, 1981, pp. 805-814.

This paper presents a numerical model by which the roughness interference area can be calculated from the geometry and roughness of the bearing and of the operational parameters such as viscosity, load, and speed.

\*\*\*\*\*

WU, Chih, Professor, "Effect of a Computer Information Management System on Shipboard Facilities Maintenance and Manpower Utilization," Applied Systems and Cybernetics. London: Pergamon Press, 1981, pp. 1074-1077.

Facilities maintenance requires a considerable expenditure of man-hours and material resources. Due to a number of problems and practices, facilities maintenance is not always performed efficiently. New concepts for accomplishing better shipboard facilities maintenance have been developed, which should improve performance, reduce man-hours and cost, and improve skill and knowledge of facilities maintenance team personnel by the addition of a computer information management system. The plan for applying different experimental conditions to experimental test ships to determine how an information management system may effect the criteria is presented in the paper. Execution of the experiment and statistical data analysis of the concepts are performed following at-sea data collection.

\*\*\*\*\*

WU, Chih, Professor, "An Educational Passive Solar Energy Collector," The International Journal of Energy Systems, 1 (August 1981), 305-306.

A passive solar energy collector which uses air as the heat-exchanging medium was designed by Midshipman E. J. Costello, Class of 1978. The collector is a wooden box of 3' x 4' x 4". Two sheets of steel painted flat black are used as collector surfaces. The upper sheet is baffled and is mounted two inches above the lower plate. Two ports, 2" x 5", one at the bottom and one at the top, allow air to flow by either natural convection or forced draft provided by the fan at the bottom. The collector plate is covered by a single pane of glass. Design consideration, performance, and analysis of the collector are given.

\*\*\*\*\*

WU, Chih, Professor, "Teaching Energy Engineering by Computer," 1981 Proceedings, International Conference on Energy Education, (August 1981), 4-7.

An instructional system is used in the computer-aided instruction project in which each student is provided with a terminal. The instructional material, optional supplementary instruction, questions, and tests are presented to each midshipman individually, enabling him to proceed at his own demand and pace.

\*\*\*\*\*

WU, Chih, Professor, "Heat Pipes and Their Potential Naval Applications," The Naval Engineers Journal, 93 (October 1981), 29-32.

The principle of the heat pipe is very simple. Phenomena involved are surface tension and the latent heat of the working fluid. There are no moving parts. Its effective thermal conductivity is hundreds of times more than conventional solid heat conductors. Substantial research in this field did not begin until 1960s. Already there have been efforts made to employ

heat pipes in various areas. The Navy can benefit from the useful characteristics of heat pipes. Several potential naval applications are discussed in the paper. More and more opportunities for the employment of the heat pipes can be realized as time goes on.

\*\*\*\*\*

WU, Chih, Professor, "Physical Modeling and Computer Graphic Simulation of the Depletion of World Energy Reserve," The Journal of the International Association for Mathematics and Computers in Simulation, 23 (December 1981), 56-62.

A physical modeling device and a computer graphic simulation program of the depletion of the world energy reserve are developed to demonstrate how rapidly our energy reserve is depleted, how quickly and enormously our demands for energy grow, and how important energy conservation is to us. In both modeling and simulation cases, the total world energy reserve, the current energy usage annual growth rate, and the current energy consumption rate are given as parameters. One can view the energy shortage in terms of the rapidly falling levels in the physical water tank or the simulated oil barrels.

\*\*\*\*\*

WU, Chih, Professor, "Computer-Aided Design of a Solar Absorption Air Conditioning System," Proceedings of the 5th International Conference on Computers in Design Engineering, (30 March - 1 April 1982), 590-596.

This paper describes a pilot interactive computer program used by midshipmen in the early phases of design of a solar absorption air conditioning system. The model has been made as simple as possible without losing the fundamental relationships of thermodynamics, fluid dynamics and heat transfer theories. The interactive program provides enough information to allow users to evaluate and design their own solar absorption air conditioning unit.

\*\*\*\*\*

WU, Chih, Professor and John O. GEREMIA, Professor, and Richard A. HIRSCH, Associate Professor, co-authors, "Computer Simulation Laboratory for Design and Experiments," Proceedings of the 20th Annual Convention of the Association for Educational Data Systems, 10-14 May 1982 .

In any course concerned with the design of experiments, students are introduced to the theory and calculations associated with various experimental plans such as factorial or Box-Behnken designs. In order to implement these plans, realistic experimental data is needed, but in the early use of these plans emphasis should be on the mechanics of their utilization and not on the difficulties of obtaining real data. For this reason, a computer simulation has been developed wherein the student can select values of the dependent variables including random errors. The student can then conduct "experiments" according to one of several plans in order to discover the main and interaction effects, the magnitude of the overall "experimental" error, and the nature of the functional relationship among the variables. The simulation program and its application are described.

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PRESENTATIONS

MECHANICAL ENGINEERING DEPARTMENT

GEREMIA, John O., Professor, "Experimentation at the U. S. Naval Academy," Measurement Science Conference, San Diego, January 1982.

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GEREMIA, John O., Professor, co-presented with Richard A. Hirsch, Associate Professor and Chih Wu, Professor, "Computer Simulation Laboratory for Design and Experiments," 20th Annual Convention of the Association for Educational Data Systems, Orlando, Florida, 10-14 May 1982.

\*\*\*\*\*

GILLERLAIN, Joseph D., Associate Professor, "Vortex Impingement on a Control Fin," AIAA Paper no. 82-0171, AIAA 20th Aerospace Sciences Meeting, Orlando, Florida, January 1982.

\*\*\*\*\*

GILLERLAIN, Joseph D., Associate Professor, "Vortex/Control Fin Interactions," AIAA/ASME 3rd Joint Thermophysics, Fluids, Plasma and Heat Transfer Conference, AIAA Paper no. 82-0950, St. Louis, Missouri, June 1982.

\*\*\*\*\*

JOYCE, James A., Associate Professor, "Static and Dynamic J-R Curve Testing of A533B Steel Using the Key Curve Analysis Technique," ASTM 14th National Symposium on Fracture Mechanics, University College of Los Angeles, 30 June 1981.

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JOYCE, James A., Associate Professor, "Experimental Verification of Teaming Instability Phenomena for Structural Materials," ASTM 14th National Symposium on Fracture Mechanics, University College of Los Angeles, 30 June 1981.

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JOYCE, James A., Associate Professor, "Instability Testing of Compact and Pipe Specimens Utilizing a Test System Made Compliant by Computer Control," 2nd International Conference on Fracture Mechanics, American Society for Testing and Materials, Philadelphia, Pennsylvania, 6 October 1981.

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PRESENTATIONS

MECHANICAL ENGINEERING DEPARTMENT

MACKNEY, Michael D. A., Lieutenant Commander, Royal Navy,  
"Axisymmetric Deformation of Thin-Walled Domes Under Uniform  
Pressure," Stress Analysis of Fabricated Structures and  
Components, Stress Analysis Group, The Institute of Physics,  
London, October 1981.

\*\*\*\*\*

MACKNEY, Michael D. A., Lieutenant Commander, Royal Navy,  
"Instability of Oblate and Prolate Hemispheroidal Domes Under  
Uniform Pressure," Stress Analysis of Fabricated Structures  
and Components, Stress Analysis Group, The Institute of Physics,  
London, October 1981.

\*\*\*\*\*

WU, Chih, Professor, "Computer-Aided Design of a Solar Absorption  
Air Conditioning System," 5th International Conference on  
Computers in Design Engineering, Brighton, England, 30 March -  
1 April 1982.

\*\*\*\*\*

WU, Chih, Professor, "Computer-Aided Education in Energy Conversion  
at U. S. Naval Academy," International Symposium on Policy  
Analysis and Information Systems, Acapulco, Mexico, 19-22  
August 1981.

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WU, Chih, Professor, "Teaching Energy Engineering by Computer,"  
International Conference on Energy Education, Providence,  
Rhode Island, 4-7 August 1981.

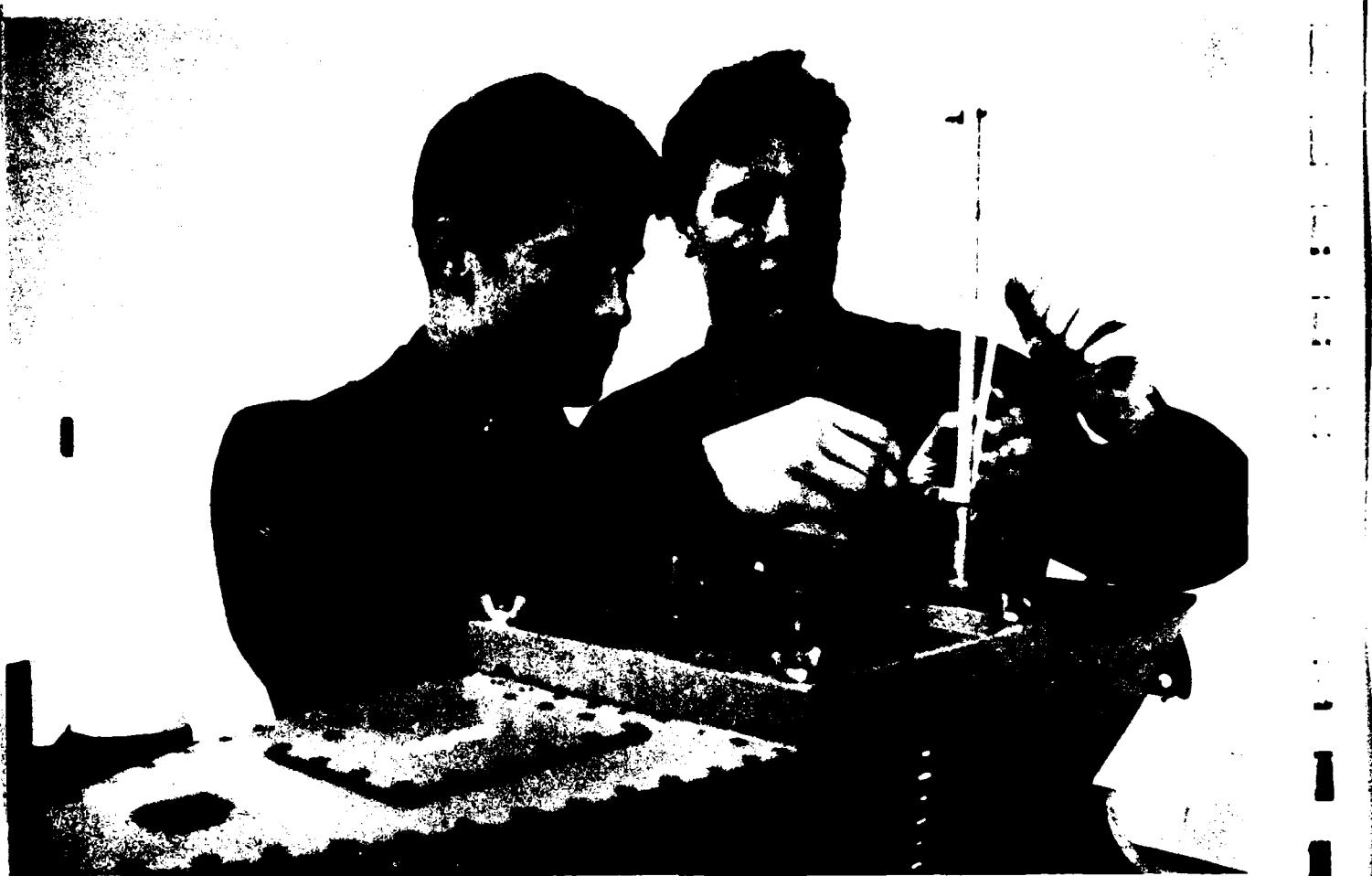
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WU, Chih, Professor, "Teaching Solar Stirling Engine Design  
Through Computer Interactive Programming," ASEE Annual  
Conference, Los Angeles, California, 21-25 June 1981.

\*\*\*\*\*

WU, Chih, Professor, "Wind Energy at the U. S. Naval Academy,"  
ASME International Wind Energy Symposium, New Orleans,  
Louisiana, 7-11 March 1982.

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## NAVAL SYSTEMS ENGINEERING DEPARTMENT

Captain Sidney E. Veazey, USN, Chairman



Research in the Naval Systems Engineering Department plays a vital role in the professional enrichment of both midshipmen and faculty. During Academic Year 1981-1982, faculty members and midshipmen participated in numerous and varied projects in the fields of marine engineering, ocean engineering and naval architecture.

A variety of projects were undertaken, both funded and unfunded. These include faculty research in the areas of scoring alternative ship's general arrangement plans against desired ship performance, shallow water ship-resistance, testing the USNA YP replacement model, irregular wave generation, surface ship non-linear wave response, seafloor dynamics, elec-

trical resistivity techniques for measuring liquefaction of sand, electric propulsion, wind and solar energy conversion, "mastless" sails, and faculty sponsored midshipman projects in the areas of computer-aided structural design, ship propeller design, electrolytic drag reduction, measurement of sail forces and moments, design and fabrication of an instrumented fall cone, the effects of stem wedges and bow bulbs on frigate performance, cryogenic H<sub>2</sub>/O<sub>2</sub> handling systems for submarine propulsion, surface wave and bottom sediment interaction, wave forces on an inclined pile, wave-energy-conversion, and calibration and tests of the Naval Academy heat-balanced diesel engine. Especially notable because of its high visibility at the pier outside Rickover Hall is the sailboat SOLAR BREEZE, which is being used to test wind and solar energy conversion, electric propulsion, electrolytic drag reduction, and "mastless" sails. A SWATH unmanned surveillance platform will soon join SOLAR BREEZE pierside. Both of these vessels will be available for future experiments within the Department and the Division at-sea research.

Support for research was found in many sources, from departmental operating funds to contracts and grants from such diverse organizations as the Naval Academy Research Council, the Naval Sea Systems Command, the Naval Civil Engineering Laboratory, the U. S. Coast Guard, the David W. Taylor Naval Ship Research and Development Center, the Office of Naval Research, and the Navy Energy Office.

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SPONSORED RESEARCH

NAVAL SYSTEMS ENGINEERING DEPARTMENT

**HYDROSTATIC LOADING OF FIBER-REINFORCED CONCRETE SPHERICAL HULLS**

Researcher: Lieutenant Bernard C. Bailey, USN

Sponsor: Naval Civil Engineering Laboratory

The purpose of this project is to determine the performance of steel-fiber-reinforced concrete when subjected to hydrostatic loading. Nine 16-inch outside diameter spherical hulls will be constructed with varying amounts of fiber reinforcement. The hulls will be loaded to failure in a hyperbaric pressure chamber and the results analyzed.

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**EVALUATION OF THE HEAT TRANSFER DESIGN CHARACTERISTICS OF HEAT BALANCED INTERNAL COMBUSTION ENGINE PISTON CAP**

Researcher: Lieutenant Commander David A. Blank, USN

Sponsor: Naval Academy Research Council

The primary objective of this analysis is to numerically determine the temperature distribution and heat-transfer rate throughout the piston cap of the Naval Academy Heat Balanced Engine through a series of cycles. Included in the analysis will be the empirical determination of the gross flow field adjacent to the boundary layer of the piston cap using digitized data obtained from Schlieren photography. The study will be conducted for a variety of piston-cap geometrics and material thermal conductivities with the intent of determining what combination of the two will both maximize the beneficial regeneration aspects of the engine while minimizing the adverse effects of heat stress in the cap.

The analysis will start with a study of the engine's thermodynamic cycle, with the objective of determining temperature and pressure of the working substance in the cylinder as a function of both time and crank shaft angle. An extension will then be made, using these profiles to the fin models of both the NABHE and adiabatic piston engine in order to determine bracketing values of the combined corrective and radiative heat transfer coefficients of the exposed surfaces of the piston as a function of time. A preliminary estimate of the regeneration aspects of both the adiabatic piston engine and NABHE will then be made.

The second phase of study will involve a detailed computational analysis of an axisymmetric adiabatic piston engine, using state-of-the-art turbulence models and numerical schemes. The regenerative characteristics of this engine will be predicted.

SPONSORED RESEARCH

NAVAL SYSTEMS ENGINEERING DEPARTMENT

The final phase of the study will involve the development of a computational program which solves the turbulent flow field of an axisymmetric model of the NAHBE and gives the temperature distribution of the piston cap for various times. This working program will then be used to do parametric studies of the piston-cap geometry and cap material construction, to optimize the engine with respect to cap heat stress and cycle regeneration.

\*\*\*\*\*

**USNA YP REPLACEMENT MODEL TEST PROGRAM**

Researcher: Professor Roger H. Compton

Sponsor: Naval Sea Systems Command, Norfolk

An extensive experimental program to quantify the still-water performance, beam-sea rolling performance, and head/following sea seakeeping performance of six variations of hull-form being considered by the U. S. Navy to replace the present YP fleet at USNA. Semiplaning hulls of soft and hard chine designs are being studied by the testing of (nominally) five-foot models. For each hull, variations of displacement, center of gravity, and weight distribution are varied over a range prescribed by the sponsor.

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**SEA FLOOR DYNAMICS**

Researcher: Associate Professor Thomas H. Dawson

Sponsor: Office of Naval Research

The objective of this research is to determine the degree to which an elastic model can describe seafloor response to overhead water surface waves. The work is continuing under ONR sponsorship and involves collaboration with personnel of the Coastal Studies Institute of Louisiana State University.

\*\*\*\*\*

**FREEING FORCES OF STRANDED SHIPS**

Researchers: Associate Professor Thomas H. Dawson, Midshipmen 1/C James Davitt, and Mark Jantzen

Sponsor: Naval Sea Systems Command

The purpose of this study is to examine the relation between the freeing force of a stranded ship, its contact area and weight aground, and the sediment strength. The study is

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NAVAL SYSTEMS ENGINEERING DEPARTMENT

an experimental one involving small-scale laboratory tests. The overall objective is to improve prediction capability of forces needed to free grounded ships.

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**EXTREME WAVE GENERATION**

**Researcher:** Professor Bruce Johnson

**Sponsor:** Naval Sea Systems Command

A microcomputer-based transient-wave-generation technique has been developed for the Naval Academy towing tanks. It utilizes a Tektronix 4051 terminal and a digital-to-analog converter to sequence a controlled frequency and amplitude sweep of the drive signal to the wavemaker. Extreme waves, including plunging breakers in deep water, have been used in capsize tests in both tanks. Current research involves attempts to characterize the important time-domain parameters in the resulting wave record. These parameters are needed in order to relate the synthesized extreme wave in the towing tank to the situations which might produce extreme waves in the open ocean.

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**SHALLOW WATER RESISTANCE STUDY**

**Researcher:** Assistant Professor Bruce C. Nehrling

**Sponsor:** United States Coast Guard

In this ongoing research project, the powering requirements for a river buoy-tender which will operate in shallow water are being determined. To date, the hull form for this vessel has been developed using the Academy's computer-aided design and interactive graphics facilities. Both a 1/30 and 1/45.5 scale-model of this hull have been cut on the model shop's numerically controlled milling machine. A false bottom has been designed and installed in the hydromechanics laboratory's 120-foot towing tank. Large quantities of experimental data have been gathered. This information is being analyzed. The results, in an operator usable format, are being made available to the Coast Guard so that they may assess the powering penalties and speed limitations inherent in shallow water operations.

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SPONSORED RESEARCH

NAVAL SYSTEMS ENGINEERING DEPARTMENT

A METHOD FOR SCORING ALTERNATIVE GENERAL ARRANGEMENT PLANS  
AGAINST DESIRED SHIP PERFORMANCE

Researcher: Assistant Professor Bruce C. Nehrling

Sponsor: Naval Sea Systems Command

As a result of this research project, which was sponsored by the Naval Sea Systems Command, a method for systematically evaluating the impact of alternative general arrangement plans on a ship's overall performance was postulated. This proposed approach employs the theory of fuzzy sets in order to provide the naval architect with an analytic procedure for making arrangement decisions. The use of fuzzy set theory helps provide a means for circumventing many of the ill-defined requirements and/or criteria typically associated with general arrangement design. Fuzzy set theory is explained. Its potential use in evaluating general arrangement designs in terms of performance objectives is shown by means of an example. In particular, fuzzy set theory was applied to such poorly quantifiable performance goals as equipment access, habitability, survivability, appearance, and growth margins.

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MASTLESS SAIL

Researchers: Captain Sidney E. Veazey, USN, Lieutenant Michael C. Tracy, USN and Professor Maito Saarlas (Aerospace Engineering)

Sponsors: Naval Sea Systems Command, and Navy Energy Office

An effective Navy does its best job by never having to engage in war. It, therefore, must do many other things with ships besides sending them in harm's way. While the nuclear age continues to mature, the need for oil continues to be an expensive requirement. Thus, the use of our natural energy sources, particularly the wind, should be of growing concern to an energy-conscious Navy.

Wind energy can be successfully harnessed for use not only by supply and repair ships, but even combatants during transit. It can be used very effectively in emergencies when reliance on a natural "prime mover" may be the last means of propulsion.

The purpose of this research is to take advantage of the available wind energy not at sea level, but where the wind speed is many times more effective in acting as a prime mover at 300-400 feet of altitude. The "mastless sail" is a "parafoil" flown by a vessel at these altitudes under which any type of sail can be hoisted via lines and blocks to use the higher wind speeds

at altitude. With a typical sport parafoil borrowed from the USMC and a moderate-sized spinnaker, a 16,000-pound, 36-foot MSL personnel launch made 4.6 knots in a 10-knot breeze. Similar successful tests have been carried out on a 19,000-lb Westsail 32 sailboat making 5 knots with the foil tending about 45° off the bow in 20 knots of wind. An ensign and a midshipman 1/C are assisting in the research for the summer. Various foil shapes and methods of control are presently being tested.

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#### UNMANNED SURVEILLANCE PLATFORM

Researcher: Captain Sidney E. Veazey, USN and Lieutenant Michael C. Tracy, USN

Sponsor: Naval Sea Systems Command

The Navy continues to be affected by a decrease in available manpower, a limited number of ships, and rising construction, fuel, and manning costs for the foreseeable future. This project explores the technology applicable to the design of a remotely-operated, unmanned platform for open ocean surveillance.

The concept is that of a Small Waterplane Area Twin Hull (SWATH) platform which can be placed at sea by a larger vessel, and left to conduct surveillance operations for an indefinite time. The vehicle would monitor its own position and, upon command, proceed under its own power to another position and maintain station. The platform would monitor ocean area by means of passive sensors. The surveillance system may be continually monitored by satellite or ship through the platform's communications system, or may be programmed to alert a monitoring station when signals of interest are detected. The platform support systems would be capable of quiet operation to avoid interference with the surveillance system. Wind, solar, and possibly ocean wave energy recovery techniques will be utilized as prime sources of power. Support system capabilities could include monitoring of system and energy status, intruder detection, navigational monitoring and control, and flooding and fire detection with countermeasures. The platform itself would consist of a saucer-shaped upper hull to minimize radar signature, with its relatively small size assisting in the covert operation of the vehicle.

Concept and detailed constructional design is complete. All required materials have been procured or are on order. Several manufacturers and the NSWC have donated materials or equipment. NAVSEA has funded the project. Two ensigns are assisting in design and construction during the summer. Structural construction is presently in progress.

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**WINDMAST/POWER KEEL**

**Researcher:** Captain Sidney E. Veazey, USN

**Sponsor:** Naval Sea Systems Command and Navy Energy Office

Much effort is being made today to utilize solar power and WECS (Wind Energy Conversion Systems) in order to conserve fossil fuels. There is a way to utilize the natural attributes of a sailboat to good advantage to generate and store energy. First, most sailboats sit pier-side or at a mooring most of the time, with the masthead at an advantageous height for a windmill. Secondly, a large mass of inert lead or iron is used for ballast in the keel. These two attributes lend themselves to use as a WECS.

A "Westsail 32" cruising sailboat was obtained from U. S. Customs and refurbished for use as an experimental platform. The boat has been renamed "Solar Breeze." Conceptual design for modification of the sailboat was completed, as well as procurement of all energy recovery systems and subsystems. Windmill and battery installation is complete with electric motor and associated electrical control equipment installation in progress. Testing is scheduled for mid July.

An additional area of research for this platform is the installation and testing of electrolytic drag-reduction equipment as conceived and designed by several professors in the Naval Systems Engineering Department.

The "Mastless Sail" concept, as discussed in a related abstract, has been tested satisfactorily on "Solar Breeze," propelling the boat at 5 knots. Testing of the concept is scheduled on "Solar Breeze" as well as other boats.

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**RESEARCH COURSE PROJECTS**

**NAVAL SYSTEMS ENGINEERING DEPARTMENT**

**SIMULATION OF WAVE-EXCITED GIRDER VIBRATIONS**

**Researcher:** Midshipman 1/C John Bell

**Adviser:** Associate Professor Thomas J. Langan

The objective of this project is to develop and use a computer program to simulate a wave excited hull vibration on a hybrid computer. The primary plan is to use the digital capabilities to compute the coefficients for the equation of motion from the ship lines and weight distribution. The analogue capabilities would be used to solve the equations of motion. The solution would be obtained digitally. The programs for the coefficients have been completed. The solution to the equation of motion must be obtained.

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**IMPROVEMENT OF NEWHULL AND ADAPTATION FOR GRAPHICS OUTPUT**

**Researcher:** Midshipman 1/C Phillip Botero

**Adviser:** Professor Rameswar Bhattacharyya

The program NEWHULL offers the ability for the naval architect to derive a suitable hull-form from a given parent by changing several different parameters. The program, as it existed, was difficult to use because of no limitations on the amount of change to the hull and no graphic output to quickly view the result.

This report discusses the changes that the program underwent to try and alleviate the two above-mentioned problems. The report also includes several sample runs that varied the most influential parameters as well as listing of the program that was involved in the project.

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**WAVE ENERGY PUMP**

**Researchers:** Midshipmen 1/C T. Brown, D. Dixon and R. Ward

**Adviser:** Professor Michael E. McCormick

Energy, with all its uses in our modern world, is becoming more and more expensive. Conventional methods of obtaining this energy are depleting our world's supplies of natural resources such as coal, oil, and natural gas. Now is the time for all engineers to explore new methods of energy production and expand on other existing systems that could be used more effectively.

RESEARCH COURSE PROJECTS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

This project employed the design and production of a wave-energy pump model. The original design was created by McCabe Delaney and Associates, College University, Cork, Ireland. This design was not very successful, so the Naval Academy research team adopted the original idea, designed a new model and tested it in the 380-foot towing tank at the United States Naval Academy. The results obtained were promising and showed that with several modifications the wave-energy pump can be a useful and productive source of power in today's highly demanding world.

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**ANALYSIS OF STRUCTURAL RESPONSE OF A HULL FORM TO WAVE EXCITATION**

Researcher: Midshipman 1/C Edward Dachowski

Adviser: Associate Professor Thomas J. Langan

The objective of this proposal is to develop experimental techniques with which to measure the structural response of a hull form to the extreme waves caused by an excited sea state. Our approach in this project is to check out instrumentation, experimental procedures, and data acquisition programs in a systematic way. Pressure distinctions are to be obtained on a 5'-model fixed and free in pitch and heave in regular waves. A spectral response function will be obtained and then used to predict response to irregular waves. Measurements will then be taken in irregular waves, and the results will be compared with the predicted results. Thus far the instrumentation has been proven to work and measurements have been made in regular waves. The next step is to determine the spectral response.

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**LOW DRAG BULBS FOR R/C SAILING YACHT MODELS**

Researcher: Midshipman 1/C Robert G. French

Adviser: Professor Roger H. Compton

Minimization of hydrodynamic drag is a common goal of ship and yacht designers. One special category of design presenting some unique flow conditions is that of radio-controlled sailing yacht models. Sizes and velocities are such that the designer is drawn toward the application of laminar flow-shapes. One such application is the body of revolution which is fixed to the bottom of a fin keel and provides concentrated low ballast. This project involves the study of the laminar flow body of revolution, the mathematical representation of such a body, and the N/C fabrication of the first of a family of five laminar flow shapes derived from NACA laminar airfoil profiles.

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RESEARCH COURSE PROJECTS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

**EXPERIMENTAL MEASUREMENT OF SAIL FORCES**

**Researcher:** Midshipman 1/C Gavin Giddings

**Adviser:** Professor Roger H. Compton

Quantitative knowledge of the forces developed by a sail allow sail-powered craft to be designed better. Such data to aid the designer is sparse, at best. The present project is an attempt to develop an experimental apparatus to facilitate sail force and moment measurement. Thrust and side forces are measured as are yawing moments, using a specially designed and fabricated frame mounted on standard laboratory force blocks.

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**AUTOMATIC ISOTOPE ANALYSIS**

**Researcher:** Midshipman 1/C Russell Janicke

**Adviser:** Associate Professor Martin E. Nelson

Objective of this research project was to acquire a working understanding of the TN-11 Gamma Ray Analysis System that is installed in the USNA Reactor Laboratory. This system was designed to analyze unknown samples through the computer inspection of characteristic spectrum omitted after neutron bombardment. By adapting the TN-11 supplied computer program to achieve sufficient reliability, this system could be incorporated into EN463 laboratory for use by midshipmen.

During the course of this project, several hardware problems developed, which restricted the operability of the TN-11 system. In addition, the radiation source for the project was to be the neutron generator. During the project, the head of the generator became depleted.

However, the project did result in the production of an isotope analysis program, which can be incorporated into the TN-11 system. A report has been issued.

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**PHASE CONTROLLED HEAVING BUOY**

**Researcher:** Midshipman 1/C P. N. Jaenichen

**Adviser:** Professor Michael E. McCormick

When a floating body in the shape of a cylinder is subjected to an incident wave, an oscillatory motion results with an amplitude which is related to the frequency and height of the

RESEARCH COURSE PROJECTS

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wave. Various methods have been employed which enable these floating devices to extract energy from wave action. However, although waves exist as a considerable source of energy, the energy is of a low-grade form in its natural state. So, in order to be economically feasible, any wave-energy-conversion device must be able to convert this low-grade form of energy to a more useful state and in sufficient quantities. This study investigates the use of a cam braking mechanism to control the motion of the heaving cylinder. This phase control is accomplished by braking and releasing the cylinder periodically during its motion of the heaving cylinder. Theoretical calculations show that a modification of the cylinder's mechanical cycle can increase the amplitude of the heave motion, which can lead to a significant increase in the amount of energy which can be extracted. Experimentation using the phase control device was attempted in an effort to prove this theory.

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OFFSHORE PILE BEHAVIOR

Researcher: Midshipman 1/C Kendall Miller

Adviser: Associate Professor Thomas H. Dawson

This project involves the study of previously published data on the response of offshore piles to lateral loading and the correlation of the data with a simple analytical model.

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THE EFFECTS OF A BOW BULB AND A STERN WEDGE ON A LARGE WATERPLANE AREA, TRANSOM-STERNED HULL FORM

Researcher: Midshipman 1/C James Righter

Adviser: Professor Roger H. Compton

It is an accepted fact that changes in the hull form of a ship will change its powering requirements and seakeeping characteristics. The purpose of this project is to study the effects of adding a bulbous bow and a stern wedge to an existing large waterplane destroyer hull. Experiments to determine still-water powering requirements and ship motion in head seas were conducted in the USNA Hydromechanics Laboratory's 120'-towing tank. These data were compared to existing data for the original hullform and presented in a formal report at the end of the semester. An oral presentation of the experimental findings was made in April to the American Society of Naval Engineers.

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PUBLICATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

BHATTACHARYYA, Rameswar, Professor, "Maneuverability Considerations in Preliminary Ship Design," Proceedings of the Second International Congress on Naval Architecture and Marine Engineering, Trieste, Italy, September 1981.

The preliminary design of a ship hull-form is normally based on the modification of a previous ship. But until now maneuverability qualities have not been considered during the preliminary design stage. The course-keeping capability of a vessel can be provided in the design by minimizing the instability and designing the control surface with adequate area which is first selected from past experience. However, the design of the control surface itself can be performed with the help of aerodynamic calculations for the isolated control surfaces as well as for one behind the vessel. A number of design charts, figures, and tables can be put together for the prediction of hull-rudder interaction.

The turning characteristics of a vessel can be determined during preliminary ship design following mathematical modeling for which the coefficients of motion for maneuverability are necessary. Numerous model tests and some analytical techniques have been performed in the past and efforts are now underway to estimate these coefficients.

This paper contains all the equations as well as the necessary charts for the maneuverability design of ships.

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DAWSON, Thomas H., Associate Professor, "Forces on a Large Scale Offshore Test Structure in Random Waves," co-author, Proceedings of the International Symposium on Hydrodynamics in Ocean Engineering, Trondheim, Norway, 1981, 509-530.

Experimental measurements of the wave force and overturning moment acting on a 5.5 meter jacket-type test structure in random waves are presented and compared with theoretical predictions based on linear theory, Sarpkaya hydrodynamic coefficients, and several idealized lumped structural representations.

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PUBLICATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

JOHNSON, Bruce, Professor, "A State of the Art Review of Irregular Wave Generation and Analysis," Proceedings of the 16th ITTC, Leningrad, USSR, September 1981, 523-530.

A state-of-the-art review of deterministic and non-deterministic irregular wave generation and analysis was made. Extreme wave generation and wave group analysis are covered in the review. Thirty-eight references are included.

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McCORMICK, Michael E., Professor, co-author, "Performance Evaluation of Generic Wave Energy Systems," Proceedings of the 8th Ocean Energy Conference, Washington, D.C., June 1981.

A design methodology is presented which can be used in selecting the most appropriate wave energy conversion system for a given site and a given purpose. The history of each of the nine generic systems is traced, emphasizing both the successes and failures of each. The positive and negative aspects of each system are discussed. For example, the Salter "Duck" is extremely efficient in converting wave energy into mechanical energy, but is very difficult to moor. Thus, the cost per kilowatt is very high. The pneumatic system has half of the Salter efficiency, but requires rather simple moorings and support systems. Thus, the cost per kilowatt is low. Much of the discussion is directed toward the pneumatic system, which is judged the most feasible.

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McCORMICK, Michael E., Professor, et. al., "An Experimental Study of Wave Power Conversion by a Heaving, Vertical, Circular Cylinder in Restricted Waters," Applied Ocean Research, 4(1982), 107-112.

Results of an experimental study of a heaving, vertical, circular cylinder show that there is a relationship between water depth, draft, and tank width for which minimum motion damping occurs. In addition, there is a minimum value of added-mass for a depth-diameter relationship. When the cylinder is in a resonant heaving condition at these "minimum" parametric values, the wave-energy conversion efficiency of the cylinder is shown to exceed the theoretically predicted maximum deep water value. Finally, for a cylinder spacing (tank width) of one radiant wavelength, the optimum depth value is shown to be four times the draft of the cylinder.

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PUBLICATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

McCORMICK, Michael E., Professor, et. al., "Wave Energy Conversion in Restricted Waters by a Heaving Cylinder/Linear-Inductance System," Proceedings of the MTS/IEEE Meeting, "Oceans '81," Boston, (September 1981), pp. 898-902.

Results of an experimental study of a heaving wave-energy converter are presented. The heaving system consists of a vertical, right, circular cylinder equipped with a linear-inductance electromechanical energy conversion device. The results show that open circuit resistance has little effect on the response of the heaving system. Furthermore, by closing the electrical circuit with a variable resistor, the performance of the wave-energy-conversion system can be optimized by matching the sum of the mechanical and open circuit impedances.

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McCORMICK, Michael R., Professor, et. al., "An Experimental Study of Water-Wave Focusing by Lens-Shaped Structures," Marine Technology Society Journal, 15 (1981), 12-17.

Results of an experimental study of wave focusing by single-curvature and double-curvature lenses are presented. The solid structures, which extend upward from the seafloor, not only focus waves, but cause reflection and diffraction. While reflection always reduces the effectiveness of lens-shaped structures, the effects of diffraction are mixed, causing constructive interference at the focal point and destructive interference at some intermediate points. When placed in random waves, the interference of the diffracted waves is found to be primarily constructive at the intermediate points. Results of the study are significant in the use of lens-shaped structures to enhance wave-energy conversion.

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McCORMICK, Michael E., Professor, et. al., "Hydro Electric Ocean Energy Conversion Systems," Proceedings of Energy in the Man-Built Environment, ASCE, Vail, Colorado, August 1981, pp. 10/1-10/10.

Hydro-electric systems used in the energy conversion of ocean waves, currents, and tides are described. The ocean energy phenomena are discussed in terms of their resource and technological potentials. It is estimated that the cumulative contribution of waves, currents, and tides to the continental United States would be sufficient to satisfy the electrical needs of 25% of the population by the year 2000.

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PUBLICATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

McCORMICK, Michael E., Professor, et. al., "Development Program Leading to an Optimized Oscillating Water Column Wave Energy Converter Featuring a Bi-Directional Turbine," Proceedings of the AIAA 2nd Terrestrial Energy Systems Conference, Colorado Springs, Colorado, December 1981, pp. 1-11.

Various aspects in the design, construction, testing, and modeling of an oscillating water column wave-energy extraction system featuring a bi-directional pneumatic turbine are presented. The system is sized to provide 125-kWe power output when experiencing 3-m waves. A novel design of a pneumatic turbine has been constructed and is awaiting the commencement of a steady-state test program. Modeling studies are described for the different components of the system as well as for the system as a whole. The objective of these studies is to optimize the energy production of the system given the constraints of the wave environment and the performance description of the turbine/generator equipment. Optimizing the design of the chamber forming the oscillating water column (including its opening to the ocean) and making improvements in turbine performance is suggested by the pending turbine tests will enhance system output.

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McCORMICK, Michael E., Professor, "On the Modeling of Ocean Moorings," USNA Report EW-13-81, October 1981.

A discussion of the modeling of ocean mooring systems is presented. The three phenomena included in the mooring study are the structural dynamics, viscous flows including vortex shedding, and surface wave dynamics. From the results of numerical examples, it is concluded that only two of the three phenomena can be modeled simultaneously. Furthermore, the model-to-prototype cable length scale cannot be less than 1/10 without experiencing acoustical radiation and cavitation on the model. Finally, simultaneous surface wave and structural scaling can only be attempted in the extreme cases of deep and shallow waters. That is where the depth-to-wavelength ratio is either greater than 1/2 or less than 1/20.

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PUBLICATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

NEHRLING, Bruce C., Assistant Professor, co-editor, Computer Applications in the Automation of Shipyard Operation and Ship Design, Amsterdam, The Netherlands, North Holland Press, 1982.

This publication contains the thirty-six technical papers presented during the Fourth International Conference on Computer Applications in the Automation of Shipyard Operation and Ship Design (ICCAS '82) which was held at the United States Naval Academy in Annapolis, Maryland, from June 7th to 10th, 1982. Technical papers were presented in the areas of: management and economics, computer-aided ship design, computer aided hull form design, computer-aided ship production, information systems for shipbuilding, and man/machine communication.

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NELSON, Martin E., Associate Professor, "Use of Failure Data In Improving Power Plant Availability," 1982 Proceedings of the Annual Reliability and Maintainability Symposium, Los Angeles, California, January 1982.

The Availability Improvement Method (AIM), recently developed by the Department of Energy, calculates the increase in power plant availability resulting from various improvement projects. The method requires accurate and detailed plant equipment failure-data, such as that being collected by utilities for the Generating Availability Data System (GADS) or other data bases. Once collected and sorted, this data is used to construct a historical power profile describing past plant operation. Based on the effect of a specific improvement project on plant operation, a hypothetical power profile is constructed and compared with the historical one. The differences in the two power profiles show the increase in plant availability. This paper describes the use of equipment failure-data as collected by GADS in the AIM method. Sample data is used which illustrates the AIM evaluation method for prioritizing plant improvement projects.

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THORNTON, Marcia A., Captain, USAF, "Computer Grade-Keeping Programs: User's Guide," Report EW-7-81, 1981.

A set of programs is available on the Naval Academy Time-sharing System to assist faculty members in the mechanics of grade-keeping and recording. This report describes the basic function of each program and provides step-by-step instructions so the novice user can fully utilize any one of the programs.

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WIGGINS, Peter F., Professor, co-author, "University Papers in ANS Transactions, with Enrollment and Degrees," Transactions of the American Nuclear Society, 39 (November 1981), 53.

Although many journals publish nuclear engineering research, the Transactions of ANS is a favorite and reflects graduate school activity. The principal contributors are schools with well-identified nuclear engineering departments, sizable staffs, and a research reactor. The size of the average nuclear engineering staff of the schools with many papers is about ten. Some 20 of the 183 schools contributed more than 70% of the papers. These top 20 schools are essentially the same as those of five years ago, with some change in order.

Since about 1960, the time that nuclear engineering programs began graduating significant numbers, schools have contributed about one-fifth of the papers. The effect on papers of meeting location (hence travel expense) can be noted: the number of papers correlates roughly with the number of Ph.D.s. The number of contributions in the Transactions from non-North American schools is small.

Since nuclear engineering has often been under older departments, identification of graduates and enrollment has been somewhat uncertain, and sources of information give different numbers. Nevertheless, BS degrees have increased steadily. Most early nuclear engineering programs were initiated at the graduate level. Later, BS programs were added; the motivation has been (a) industrial demand for BS graduates, (b) a necessity to feed graduate programs, and (c) a need for more administrative influence on distribution of both school budgets and staff positions, which is often weighed toward departments with undergraduate enrollment (i.e., more students). MS degrees seemed to have peaked a few years ago; the Ph.D. graduates have decreased maybe one-third since 1970. This decrease probably relates to the demand and salary for BS and MS graduates and the reduced financial support for graduate students, e.g., limited fellowship programs. Studies show the number of foreign students receiving Ph.D. degrees in engineering rose from 10% in 1968 to 35% in 1978 for nuclear engineering; the number of foreign students went from 22 to 37% from 1973 to 1978. These doctoral figures and the

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foreign percentage probably portend difficulties in staffing faculty and industry in the United States.

In conclusion, universities continue to contribute much to the Transactions, and nuclear engineering is becoming increasingly identified at the BS level. The data on papers and degrees, particularly Ph.D.s, deserve serious attention by those in government and industry concerned with graduate student support.

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PRESENTATIONS

NAVAL SYSTEMS ENGINEERING DEPARTMENT

BHATTACHARYYA, Rameswar, Professor, "Maneuverability Considerations in Preliminary Ship Design," Second International Congress on Naval Architecture and Marine Engineering sponsored by the International Maritime Association of the East Mediterranean, Trieste, Italy, September 1981.

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BISHOP, Douglas L., Assistant Professor, "Training and Reading Level," Industrial Conservation Technology Conference, Houston, Texas, 5 April 1982.

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KIDERA, Edward H. IV, Instructor, "A Motion-Compensated Launch/Recovery Crane for Towing of Oceanographic Instruments," Winter Annual Meeting of ASME, Washington, D.C., November 1981.

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TRACY, Michael C., Lieutenant, USN, "State of the Art in the Design of Advanced Marine Vehicles," Severn Technical Society Meeting, 18 March 1982.

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VEAZEY, Sidney E., Captain, USN, "Engineering at the U. S. Naval Academy," Navy League of the United States National Engineers Week Meeting, Pittsfield, Massachusetts, 26 February 1982.

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WIGGINS, Peter F., Professor, co-author, "University Papers in ANS Transactions, with Enrollment and Degrees," Annual Meeting of the American Nuclear Society, San Francisco, California, 22-26 November 1981.

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## WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

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*Professor Charles F. Olsen, Chairman*



The Weapons and Systems Engineering Department provides and maintains an environment in which research activities contributing to the professional growth of the faculty and outstanding midshipmen flourish. Such research, in addition to keeping both faculty and midshipmen abreast of today's rapidly advancing technology, ultimately improves the academic environment by providing examples of, and solutions to, existing problems. Where research is based on problems posed by the U. S. Navy, the association causes the academic environment to be more relevant to the professional development of midshipmen.

Faculty research is regularly undertaken by nearly all civilian members of the Weapons and Systems Engineering Department and on occasion by some military members as well. Funding for research activities is available from several sources, including grants or contracts from various federal agencies as well as funding support from within the Naval Academy. Current contracts have been made by faculty members with both the Naval Surface Weapons Center, the Naval Air Development Center, and the Naval Research Laboratory. Excellent faculty and midshipmen research relations have additionally been established with the David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory.

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**RESOURCE SHARING FOR MICROCOMPUTERS**

Researcher: Associate Professor C. George Brockus

Sponsor: Naval Academy Research Council

Several microcomputer systems are available for use in the department. These systems are available to users with a wide variety of backgrounds for application in many diverse project areas. It is not economically feasible to provide mass storage or sophisticated peripherals for each simple system. Conversely, in order for the systems to be used easily by the novice, there must be access to mass storage for program development and for access to the existing library of utility software routines.

The solution is to connect the simple systems in a common communications network with a master system, the latter having the required mass storage, sophisticated peripherals and sophisticated operating system software. The overall design philosophy has been to connect the master system to several "nodes" via asynchronous serial data links, and to establish a parallel communications bus at each node interconnecting several simple systems. The efforts of previous years, including an ES495 project, established the methodology and software for the serial communications between the master system and the nodes.

The efforts of this project were devoted to refining the hardware, and establishing the software, for the mechanization of the parallel communications link between the simple systems at the node level. The IEEE 488 bus system was adopted as the primary vehicle for this parallel system. Various versions were used for both the master and slave cards, prototyped for use with the S100-bus systems of the department. Although the parallel bus controller at each node will not be a full S100-bus system, the prototypes were all run on that system.

The exact configuration for the master system is not known. The procurement phase for that system was terminated during the year, and the process restarted due to a lack of suitable responses to the request for bids. Therefore, it remains to refine the software procedures to the capabilities of the master system when it arrives. The final form for the parallel-bus controller, at the node level, also remains to be established.

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APPLICATION OF MAGNETOELASTIC RIBBON TO ROBOT FORCE AND TORQUE SENSORS

Researcher: Assistant Professor Robert DeMoyer, Jr.

Sponsor: Naval Surface Weapons Center, White Oak Laboratory

Proposed Naval applications of industrial robots require force and torque feedback signals. In place of conventional strain gauges, the use of magnetoelastic ribbon is being investigated. A strong mechanical-to-magnetic coupling in the material produces a high level signal, applicable either to the measurement of force or torque.

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APPLICATIONS OF STOCHASTIC OPTIMAL CONTROL TO NETWORKS

Researcher: Assistant Professor Richard V. Houska

Sponsor: Naval Academy Research Council

The research work being carried out under this grant was begun by identifying specific network problems to which a particular type of stochastic control model can be applied. Included among these network problems are:

(1) Minimum path problems - variations of the so-called "traveling salesman problem."

(2) Minimum transit time problems - identifying a path through a network which represents an optimal stochastic control that steers the process from the initial state to the target state in minimum average time.

The optimal control approach to solving these problems is considerably more efficient than traditional ones which rely primarily on exhaustive searches. Network problems like these arise in many tactical communications, control, and computer systems, and effective methods of finding solutions to them should be of significant practical value to the Navy.

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**DYNAMIC MODELS OF REGENERATIVE CYCLE GAS TURBINE ENGINES**

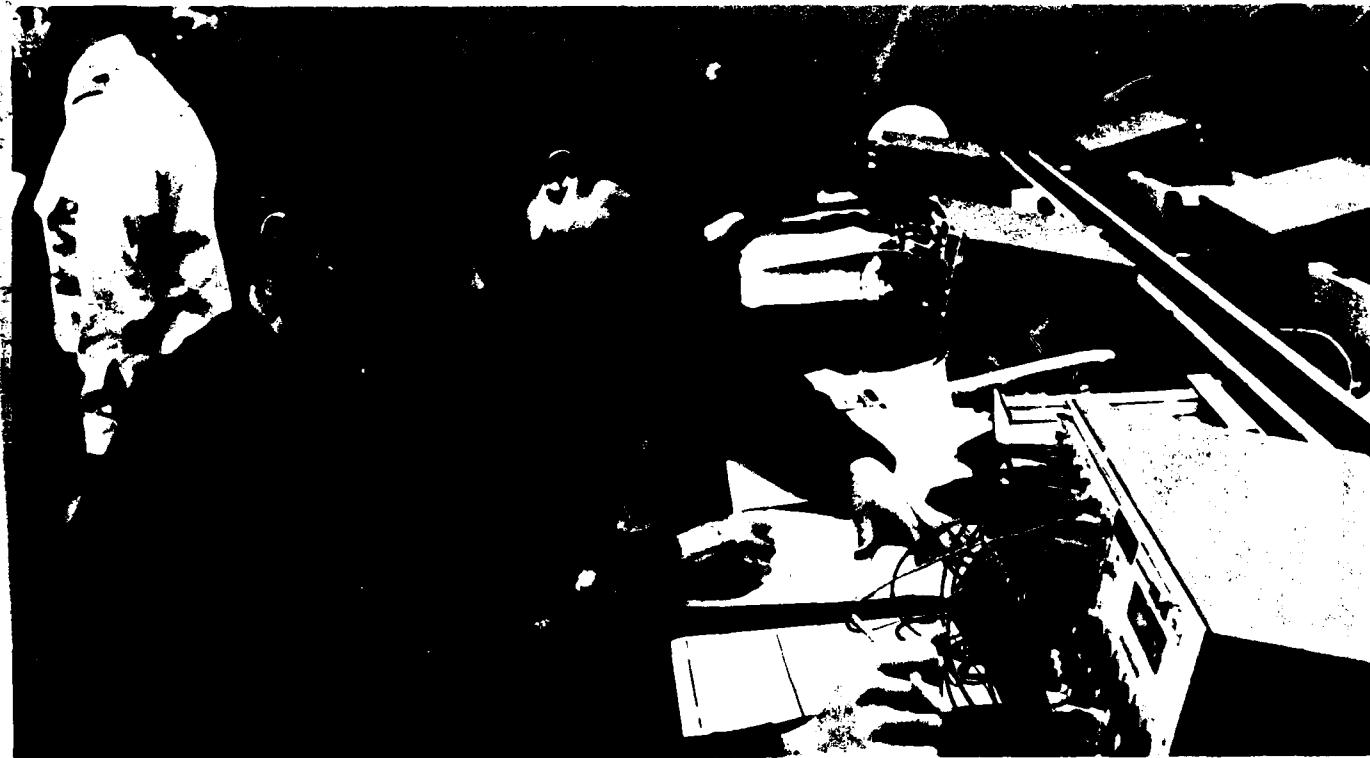
Researcher: Assistant Professor Jerry W. Watts

Sponsor: David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The addition of a heat exchanger to a gas turbine engine to reduce fuel consumption by using exhaust heat can result in transient problems for the engine. For example, in a drop-load, over-speed condition, a heat exchanger would aggravate the situation.

A dynamic model is being developed which will investigate this problem. The model will effectively simulate any gas turbine engine including intercooled regenerative engines and variable geometry engines. It is likely that special controls will need to be developed to protect regenerated gas turbine engines from some of the transients which may occur.

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**MICROCOMPUTER-MANAGED CLIMATE CONTROL SYSTEM STUDY**

Researcher: Midshipman 1/C Richard A. Delong

Adviser: Associate Professor Kenneth A. Knowles

The purpose of this independent research project was to design and implement a microcomputer-controlled heating control system on a scale model of a single family house. The scale model house, measuring approximately three feet by seven feet, was constructed of sheet aluminum. It contained seven rooms, and two heating unit (furnace) locations. Solenoid-activated supply ports controlled the amount of hot air flowing to each room. The locations and heat loss effects of windows and doors were simulated by the presence and absence of varying amounts of external insulation. Thermistors located in the various rooms provided temperature-feedback information for use by the controlling Intel 8085 single-board microcomputer. Conventional thermometers were located adjacent to the thermistors to provide visual indication of room temperatures. A modified 1000-watt personal hair dryer was used as the heating unit. This project was completed with the implementation of all of the necessary interface and control circuits. An 8085-based microcomputer, analog/digital converter circuits, actuator drive circuits, and associated software were developed and implemented during the follow-on (ES402) phase of this project. A simplified temperature control strategy was also developed.

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**MICROCOMPUTER CONTROLLED ELECTRIC POWERED MECHANICAL ARM**

Researcher: Midshipman 1/C William K. Galt

Adviser: Associate Professor Kenneth A. Knowles

The goal of this independent design effort was to develop a microcomputer interface for controlling a small electric drive mechanical manipulator. Elementary software routines were developed for demonstrating the control loops directed by the single-board Intel 8085 microcomputer. In addition to developing the electronic control and power interface circuits which link the microcomputer and manipulator, modifications to the gripping device were also effected. The resultant robot device is to be used as a test vehicle for future midshipman design projects.

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**MICROPROCESSOR CONTROL OF A SYNTHESIZER**

Researcher: Midshipman 1/C David T. Murray

Adviser: Assistant Professor Robert DeMoyer, Jr.

This project was the development of a computer music system. The work included planning the capabilities of the system, choosing the actual devices to accomplish the goal, and actually building a computer-synthesizer. The hybrid device played music from information stored in the computer. The project was part of a larger project to develop this music system, and was continued in ES402. The final outcome of the total project was a musical device that spanned the entire range of pitch, tone, color, and character, without the need of a skilled musician.

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**HYBRID COMPUTER AUTOMATIC PATCHING SYSTEM**

Researcher: Midshipmen 1/C Miguel Rodriguez and Clem Segura

Adviser: Associate Professor E. Eugene Mitchell

The hybrid computer system in the Weapons and Systems Engineering Department, like all hybrid systems, is a single-user machine. Although the digital computer portion could be operated in a time-shared mode, the analog portion cannot. Because the computer can support only a single user at a time, a limited number of students may take the hybrid course each semester.

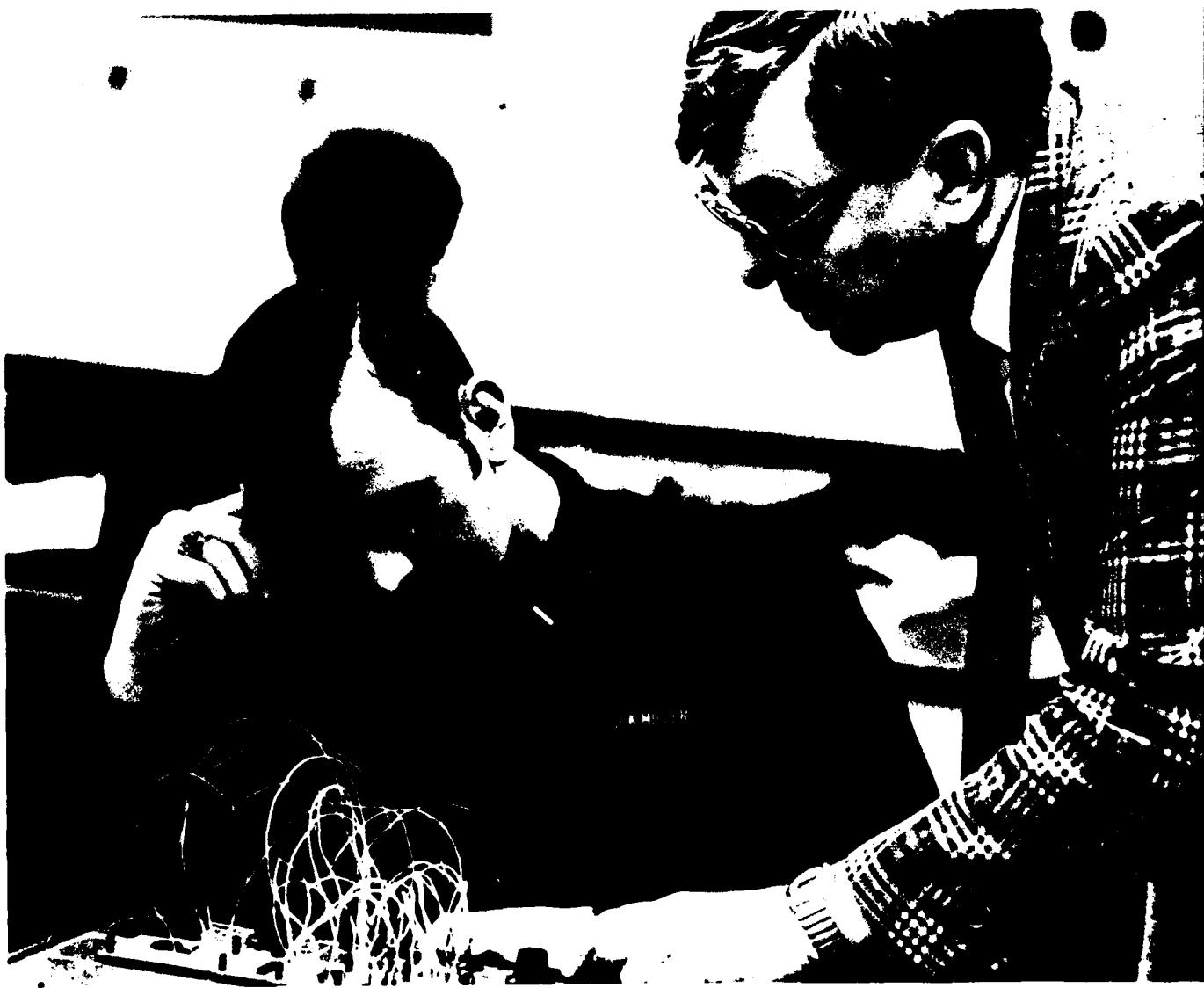
The objective of this project was to implement a computer-controlled automatic patching system for the analog computer portion of the hybrid computer. When finally implemented, the digital computer could close an electronic switching matrix which would patch or wire the analog computer program in about 5 milliseconds. This compares to approximately 20 minutes of operator time.

The final concept is then to time-share the digital computer. This would allow multi-user program development. When one of the users is ready to run the analog system, the digital computer will auto-patch his analog program, give this user highest priority, and allow him to operate in the hybrid mode, which is essentially single-user. The analog computer may have only one program wired at a time, but the auto-patch will allow

programs to be changed very quickly. This mode of operation is generally called time-slicing rather than time-sharing.

The project had three main pieces: hardware design and construction, PDP15 software development and microcomputer software. All three parts were finished and were shown to operate together by the end of the semester. No further data was taken.

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BROCKUS, C. George, Associate Professor, "Scaling State Equations," Modeling and Simulation, 12 (1981), 753-758.

A method is presented for estimating scale factors for equations in state-space form. The ratios of those scale factors are seen to be of primary importance in scaling the system matrix. The actual ratios constitute a highly dependent set. Desire-ratios are defined in such a way as to place all scaled coefficients within one order of magnitude of unity. Those desired ratios do not satisfy the dependency constraints, however. An error-vector is defined to measure the difference between the actual ratios and the desired ratios. An optimal set of ratios can be found by minimizing that vector. The errors can be weighted in a systematic manner, however, in order to obtain a better set of actual ratios. The need for time-scaling can be detected in this process.

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DeMOYER, Robert, Assistant Professor, and E. Eugene Mitchell, Associate Professor, "AN-WLQ-4 Test Program Set Acceptance Test Procedure," Report EW-15-81, Naval Surface Weapons Center, White Oak, Maryland, 1981.

The armed forces are currently experiencing serious difficulties with the maintenance of complex electronic equipment. In an attempt to cope with the maintenance problem, complex and expensive automatic-printed circuit-board-testing machines are being purchased. These machines have a digital computer which controls all test steps via a software program. The testing machines and the testing software are sold separately. The primary problem with software is that a new program must be written for each printed circuit card, and the program must be changed each time a change is made on the card.

This report details an acceptance-test procedure for the new programs being written. It permits the Navy to purchase a program from any vendor and have some assurance that the program actually performs as the contract specifications state it must. This procedure is currently being used by IBM, Watkins-Johnson, and others to bid on automatic test equipment software. It is expected to become a mil-standard in the near future.

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HOUSKA, Richard V., Assistant Professor, "A Statistical Simulation Approach for Evaluating Measurement and Estimation Techniques in an Undergraduate Servomotor Lab," 1981 Summer Computer Simulation Conference Proceedings, 1981, 470-475.

A typical servomotor laboratory setup includes a DC armature-controlled servomotor surrounded by velocity and position feedback. A primary goal in working with this equipment is to compare analytically predicted system-response to observed response. Parameters of the transfer functions are estimated from large amounts of measured data in such a way as to minimize the effect of measurement error.

Simulation is used to illustrate concepts surrounding least-squares parameter estimation. Simulated pseudo-Gaussian random numbers are graphically demonstrated by histograms. Scattergrams demonstrate the concepts of independence and correlation between random variables. A general matrix expression for the least squares estimate is applied to estimate a constant and a proportionality constant. In both cases, numerical results, derived from simulated data, confirm the accuracy of the estimators as well as the expressions for estimate standard deviation. Finally, the techniques, are adapted to the estimation of the motor-time constant, a parameter not linearly related to the measurement.

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HOUSKA, Richard V., Assistant Professor, "Stochastic Optimal Control Applied to Deterministic Network Problems," Thirteenth Annual Pittsburgh Conference on Modeling and Simulation Proceedings, (1982).

A stochastic optimal control model is used to solve certain minimum path and minimum transit time-problems in networks, including a version of the famous traveling salesman problem. The correspondence between a stochastic control model and deterministic problem is established by considering the minimum expected time optimal control as a permutation of system states which is equivalent to the shortest path through the network. In addition a computationally-efficient algorithm for finding the optimal control is developed and used to provide numerical results for several example problems. The algorithm itself can easily be programmed on a digital computer.

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HOUSKA, Richard V., Assistant Professor, "Using Matrix Methods to Find Optimal Controls for Certain Stochastic Models," Third International Conference on Mathematical Modeling Book of Abstracts, 1981, 303.

This paper considers the problem of finding an optimal control for a particular type of stochastic control problem. Obtaining a numerical solution for many stochastic control problems entails a nontrivial exercise in digital computer programming. Further complicating matters from an engineering standpoint is the fact that an understanding of abstract stochastic control theory requires a level of mathematical sophistication not possessed by the typical engineer, even with an advanced degree. Although potentially programmable procedures do exist for many stochastic control models, they are often imbedded in abstract theory, and thus are not likely to be exposed to and tested by the engineering community. One way of closing this gap between theory and practice is to develop the theory in mathematical terms already understood by those who would apply it.

The dynamic models considered in this paper are discrete-state, discrete-time Markov processes defined over a finite state space. Results for finding optimal controls involve manipulation of special matrices associated with a class of admissible controls, and can be readily programmed on a digital computer. The theoretical part of the results provide a complete characterization of the optimal control in terms of a matrix operator.

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MITCHELL, E. Eugene, Associate Professor, "Design of a New Torque and Grip Sensor," Sixth International Robotics Conference Proceedings, June 1982.

The United States Naval Surface Weapons Center at White Oak, Maryland, is actively engaged in research in the areas of robotic systems and robotic sensors. One area involves the development of a torque and grip sensor for use in a robot hand. The heart of the sensor is an amorphous magnetoelastic ribbon. When stressed, the ribbon magnetic dipole orientation is changed, resulting in a change in magnetic properties. When detected by appropriate circuitry, a sensitive voltage to stress ratio is obtained. This concept produces a force sensor with a gauge factor greater than that of a semiconductor strain gauge.

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MITCHELL, E. Eugene, Associate Professor, and Robert DeMoyer, Assistant Professor, "Fixed Point Microcomputer Control Using State Variables and Observers," Report EW-16-81, Final Report to the Naval Academy Research Council, 1981.

A digital controller is derived which causes a single-input single-output plant, defined by its transfer function, to respond according to a specified model transfer function. While incorporating a state variable observer and state variable feedback control, the algorithm is implemented by two different equations. General results relate controller accuracy to sampling time, and to microcomputer data, coefficient, and computational word lengths.

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PUBLICATIONS

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

MITCHELL, E. Eugene, Associate Professor, "Frequency-Response Calculations with a Programmable Calculator," CoED Journal, 1 (May/June 1981), 8-12.

The frequency response of a linear system is the steady-state response of the system to a sinusoidal input. The sinusoid is a unique input signal because signals throughout the system, including the output, are sinusoidal in the steady state; they differ from the input only in amplitude and phase angle.

Frequency response technique may be used to experimentally determine the transfer function of an unknown system. Equally as important, given a system (perhaps represented as a transfer function), the frequency response of the system provides valuable information about bandwidth, noise rejection, etc.

Generally, those familiar with automatic control and frequency response techniques are familiar with the straightline approximation methods used to sketch Bode plots. These are quick and easy, but sometimes they lack sufficient accuracy. Correction factors improve the accuracy but make the procedure slower and more complex.

Numerical techniques exist that are simple, easy to program, don't require a large computer, and will quickly calculate the frequency response of large (tenth-order) systems. If one has a readily available time-sharing system, the referenced program is useful. On the other hand, batch-oriented computer systems may have a turn-around time which has no relation to problem size.

For frequency response calculations, the use of a programmable calculator can provide higher accuracy than straight-line approximations and faster turn-around than batch processing. In fact, the author has found that a programmable pocket calculator is often faster for small problems than a readily available time-sharing system.

Because of the limitations on program steps and memory storage, programs for small calculators tend to be very specific, i.e., the user generally solves a specific problem, rather than programming the solution to a class of problems. This is a familiar dilemma - the smaller the computer, the more the onus is on the user; hence computers tend to grow.

This paper describes a program written for a programmable pocket calculator that computes the frequency response of linear systems. The systems are represented as transfer functions in which the numerator and denominator have been factored.

The program is quite flexible, but the user must provide some of the steps.

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PUBLICATIONS

WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT

MITCHELL, E. Eugene, Associate Professor, and Robert DeMoyer, Assistant Professor, "Interim Progress Report on Robot Sensor Design, 6/15/81 through 8/15/81," Report EW-14-81, Naval Surface Weapons Center, White Oak, Maryland, 1981.

This report is a summary of the early stages of an investigation into the use of magnetoelastic ribbon as a force and torque sensor to be used in robotic applications. It is demonstrated that ribbon stress causes a change in B-H curve slope of the material, and therefore a change in inductance of a coil wound around the ribbon. Circuits to detect this change, consisting of a flyback oscillator and of an astable multivibrator proved to be unsatisfactory. The final detector design places the coil in the negative feedback path around an operational amplifier.

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MITCHELL, E. Eugene, Associate Professor, "Magnetoelastic Force-Feedback Sensors for Robots and Machine Tools." Sixth International Robotics Conference Proceedings, June 1982.

The objective of this paper is to describe the Naval Surface Weapons Center (NSWC) Program for developing high performance, simple, rugged, cost effective magnetoelastic force-feedback sensors for robots and machine tools. Recent advances in magnetoelastic materials technologies have paved the way for corresponding improvements in the state-of-the-art in force-feedback sensors for robots and machine tools. Also, NSWC has designed magnetic circuits which are easily adapted to force-feedback sensors. In this paper, magnetoelastic materials are described along with the properties that make them potentially such outstanding force-feedback sensors. Following this, the Naval Surface Weapons Center Program is detailed including advances in materials research, in simple, low cost electronic and magnetic circuits, and designs for force-feedback sensor modules. The results are in the public domain.

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MITCHELL, E. Eugene, Associate Professor, "Microprocessors in Systems Engineering at the U. S. Naval Academy," CoED Journal, 11 (May/June 1982), 2-7.

An attempt is made to describe, in some detail, the process and evolution of the introduction of microprocessors into the Weapons and Systems Engineering Department at the U. S. Naval Academy. The Systems Engineering Department is now a heavy user of microprocessors, but has a non-electrical curriculum. Several planning decisions are discussed which were found to be extremely valuable. Some of the uses of microprocessors in the department are mentioned and the impact on the major and curriculum is considered.

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WATTS, Jerry W., Assistant Professor, co-author, "Regenerated Marine Gas Turbines, Part II: Regenerator Technology and Heat Exchanger Sizing," 27th International Gas Turbine Conference Proceedings, April 1982.

An overview of regenerator technology is given which includes: definitions of performance parameters such as effectiveness and pressure drop, a discussion of regenerator types, and comments on regenerator materials, life, maintenance, and fouling. Trade-offs between size, weight, and performance of plate-fin recuperators are examined using two hypothetical engines from Part I as examples.

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**PRESENTATIONS**

**WEAPONS AND SYSTEMS ENGINEERING DEPARTMENT**

BROCKUS, C. George, Associate Professor, "A Resource-Sharing Network for Microcomputers," Middle Atlantic Section Meeting American Society for Engineering Education, Widener University, 7 November 1981.

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HOUSKA, Richard V., Assistant Professor, and Robert DeMoyer, Jr., Assistant Professor, "A Statistical Simulation Approach for Evaluating Measurement and Estimation Techniques in an Undergraduate Servomotor Lab," 1981 Summer Computer Simulation Conference, Washington, D. C., July 1981.

\*\*\*\*\*

HOUSKA, Richard V., Assistant Professor, and C. George Brockus, Associate Professor, "Stochastic Optimal Control Applied to Deterministic Network Problems," Thirteenth Annual Pittsburgh Conference on Modeling and Simulation, Pittsburgh, 23 April 1982.

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HOUSKA, Richard V., Assistant Professor, "Using Matrix Methods to Find Optimal Controls for Certain Stochastic Models," Third International Conference on Mathematical Modeling, Los Angeles, July 1981.

\*\*\*\*\*

WATTS, Jerry W., Assistant Professor, "Regenerated Marine Gas Turbine, Part II: Regenerator Technology and Heat Exchanger Sizings," 27th International Gas Turbine Conference Sponsored by ASME, London, England, 20 April 1982.

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DIVISION OF  
ENGLISH AND HISTORY

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SUMMARY OF RESEARCH ACTIVITIES ACADEMIC DEPARTMENTS  
1981-1982(U) NAVAL ACADEMY ANNAPOLIS MD W L HEFLIN

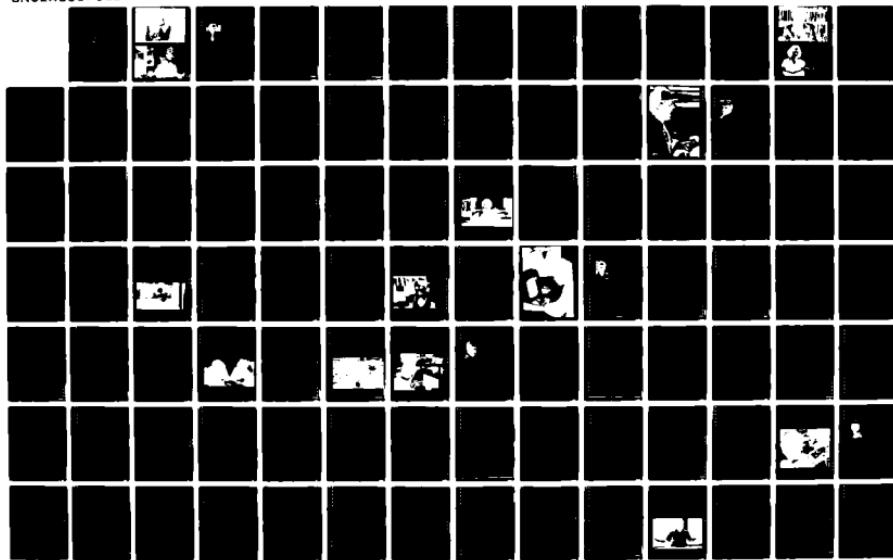
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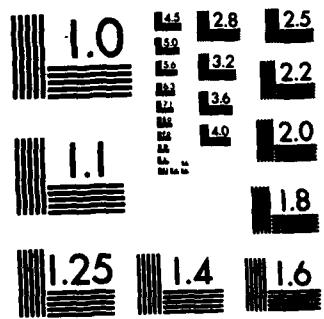
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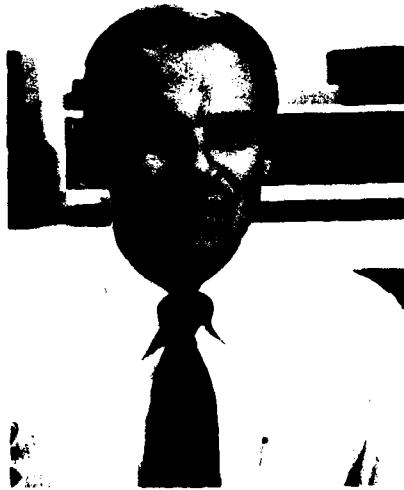


MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A



## ENGLISH DEPARTMENT

Associate Professor Fred M. Fetrow, Chairman



For faculty members of the English Department, Academic Year 1981-1982 was an active and productive time for literary research, creative writing, and scholarly publication. Two projects were sponsored by the Naval Academy Research Council: a study of Alfred, Lord Tennyson and the conventions of madness and an analysis of the relevance of a letter by Samuel Foote to eighteenth-century satire. Twenty-five independent (non-funded) projects included critical and biographical studies of American and British authors and other subjects.

Two books by members of the English faculty were published: an anthology of sea poetry and an edited collection of creative writing by students and teachers. Other publications included a monograph, two articles in books, contributions to an international bibliography, and six articles in the professional journals. One English faculty member wrote a one-act play that was produced on five occasions, another member completed a book-length biographical and critical study of an American poet, and another member was completing the writing of a novel. The staff of the Arnoldian, all members of the English Department, produced three issues of this literary journal, subtitled A Review of Mid-Victorian Culture. Creative writing of midshipmen majors in English appeared in Labyrinth, an annual publication. And seven faculty members made 12 presentations at meetings of professional organizations.

Research, critical investigation, and creative writing by members of the English faculty enhance the quality and vitality of instruction in the classroom as well as the scholarly reputations of those involved and the Naval Academy they represent.

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SPONSORED RESEARCH

ENGLISH DEPARTMENT

SAMUEL FOOTE'S UNKNOWN LETTER AND ITS RELEVANCE TO EIGHTEENTH-CENTURY SATIRE AND THEATER PRACTICE

Researcher: Ensign Mary C. Murphy, USNR

Sponsor: Naval Academy Research Council

This article will be composed of a translation from French into English of an unknown letter of Samuel Foote and an explanation of the historical context of the letter and how the letter fits into Foote's life. The value of the article lies in the fact that this satiric letter is completely unknown to eighteenth-century theater scholars. Furthermore, we know comparably very little about Samuel Foote, an important actor, playwright, and theater manager of his time. This letter and its historical references will tell scholars more about the man, about his satiric purpose and methods, and about the events that broke his health and led to his death.

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TASTE AND THE ORATORS: AN EDITION OF TWO PLAYS OF SAMUEL FOOTE, WITH FIVE INTRODUCTORY ESSAYS

Researcher: Ensign Mary C. Murphy, USNR

Sponsor: Naval Academy Research Council

This book presents editions of two of Foote's representative plays. The introductory essays deal with Foote's theory of comedy, the fact that Foote wrote comedy and not farce, his standards of taste and judgement, including false taste and standards, painting, sculpture, and medals, Foote's framing techniques, and his satire of the British Elocutionary Movement. The editions include an editor's preface, historical collations, a list of press-variants, textual notes, and historical notes.

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## TENNYSON AND THE CONVENTIONS OF MADNESS

Researcher: Assistant Professor Nancy R. Wicker

Sponsor: Naval Academy Research Council

This project will first investigate and establish the techniques that writers use to depict the mad poetic speaker. Second, it will focus on the works of Alfred, Lord Tennyson because the poetic voices of these fictional madmen reverberate most patently in nineteenth-century literature, and Tennyson is the last great poet of the age.

The crazed persona of "Saint Simeon Stylites" and the demented speaker of the monodrama *Maud*, one of Tennyson's major poems, present the reader of literature and the literary critic as well with an intriguing problem. For here, in these works, neither a title, an authorial voice, nor an objective character prepares the reader for the speaker's ensuing madness. And here too the mad narrators speak not in prose but in verse, a medium itself often thought to border on madness.

This project will attempt to answer the question of how we as readers and critics can distinguish the mad poetic narrator from the sane. Madness flourishes in Elizabethan drama and verse--the mad-song stanza has its beginning here--and Shakespeare uses madness as satiric prophecy most skillfully. In the eighteenth century, the Augustan response to madness is denial. With the turn of the century, however, comes a turn in the attitudes and concepts, and the nineteenth-century Romantic embraces madness: for the mind going out of control is a mind whose horizons are boundless though one whose fate is uncertain. This age of self-expression sees madness as growing from either an overintense or inactive will, from emotions of melancholy or sublimity.

But the true nature of the mad poetic speaker lies in the language itself, in the linguistic conventions of exaggerated phonic patterning, of bizarre imagery and bold metaphor, or radically compressed syntax, of infantile diction, and of other linguistic devices yet to be discovered. And these conventions of madness culminate in the nineteenth century with Tennyson. His age is obsessed and half maddened itself with the radical theories that led to Freudian psychology, Darwinian science, and Marxist sociology, but it is equally obsessed with the language theories of Müller, Trench, Renan, and Skeat. And not only is Tennyson the poet concerned with the workings of language, but he himself was haunted by a fear of madness.

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**PARANOIA IN CONTEMPORARY AMERICAN FICTION**

**Researcher:** Assistant Professor Neil Berman

This is a long-term project in which the researcher will define paranoia as a central theme in contemporary American fiction. Starting with Joseph Heller and Ken Kesey, the study will show the connections between black humor as a technique/philosophy and the protagonist's paranoia that a conspiracy overwhelms his freedom. This theme becomes central in the work of Thomas Pynchon. In Jerzy Kosinski and William Styron there are interesting manifestations of the same problem, but with different implications. The project will proceed by stages as individual authors are analyzed in separate essays.

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**DELIGHT OR DISILLUSIONMENT: THE DEVELOPMENT OF MIRANDA'S DEATH WISH IN KATHERINE ANNE PORTER'S "PALE HORSE, PALE RIDER"**

**Researcher:** Assistant Professor Marlene C. Browne

Using a psychoanalytic approach, the researcher is making an in-depth investigation of the dream symbols in Katherine Anne Porter's "Pale Horse, Pale Rider." She finds that when the images, symbols, and myths (Miranda's metaphors) are examined separately and then together, they reveal the living totality of Miranda. Miranda is depressed and despairing; she is consumed with an inadvertent death wish over which she has no conscious control. The symbols in her dreams unite into a meaningful pattern that reveal her experience on many different levels--unconscious and conscious; historical and present; sensual and intellectual; and social and individual. There exists a unity and inner consistency that demonstrates that Miranda's dreams are oriented in a particular and specific direction that clearly reveals how she sees the world and sees herself in it.

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**AN APPARENT ACHILLEOS FANTASY**

**Researcher:** Lieutenant Commander C. Herbert Gilliland, USNR

The Purpose of this study is to prepare a note on an apparently fictitious 3rd century Roman Egyptian tetradrachm. In 296 A.D. the Roman emperor Diocletian faced a revolt in the imperial province of Egypt, led by Domitius Domitianus, who claimed the imperial title for himself. As part of that claim he struck coins, a traditional prerogative of sovereigns.

INDEPENDENT RESEARCH

ENGLISH DEPARTMENT

Domitius Domitianus was quickly defeated, and his coins are rare. His leading colleague, Aurelianus Achilleus, of whom very little is known, may also have briefly claimed sovereignty. No coins are known for Achilleus. Recently, a specimen, an apparent Roman Egyptian tetradrachm, has appeared which by its inscription must be assigned to Achilleus. Certain oddities about this specimen might be explained by the stressful circumstances of Achilleus' ephemeral ascendancy. However, it seems wiser to consider it a fantasy piece rather than a genuine product of Achilleus' very brief and now very obscure moment in history.

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KING LEAR III. ii. 25-36: THE FOOL'S "CODPIECE" SONG

Researcher: Lieutenant Commander C. Herbert Gilliland, USNR

The researcher suggests a new reading of this apparently odd passage in one of Shakespeare's most important works. One's understanding of this passage turns on the meaning of the crucial verb "louse." Samuel Johnson first suggested in print that it here meant "to make lousy," and editors (including those of the OED) have ever since tended to follow him. However, a case can be made for reading the word with precisely the opposite meaning, "to rid of lice, to make clean." Such a reading would be in consonance with usage of the time, and integrates the Fool's song smoothly into its textual and dramatic context.

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THE LIFE OF CAPTAIN ALONSO DE CONTRERAS

Researcher: Lieutenant Commander C. Herbert Gilliland, USNR

The researcher is preparing a fully annotated and illustrated edition of the book-length autobiography of a Spanish professional soldier who served as a galley captain for the Knights of Malta and as an infantry officer in the Spanish Army, during the period 1595-1630. His voyages took him throughout the Mediterranean and to the Caribbean. His picaresque narrative compares interestingly with the fiction of the time and, with proper annotation, will provide a valuable picture of everyday military life and small-unit operations during the period covered.

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**DETAINED BY "CIRCUMSTANCES CONNECTED WITH THE SHIP"**

Researcher: Professor Wilson L. Heflin

This collaborative project is an analysis of a hitherto unnoticed letter from Allan Melville to his brother Herman, 17 October 1844. The letter gives a very detailed account of the activities of family members during Herman's absence (3 January 1841-14 October 1844) in whalers and the frigate United States. It also expresses great concern over the fact that Herman had not been discharged from the frigate, but, according to an apparently lost letter from Herman to Allan, had been detained by "circumstances connected with the ship." The researchers will attempt to determine what these "circumstances" were and whether Herman had been deliberately ambiguous in writing his brother.

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**INTERSUBJECTIVITY IN WALKER PERCY'S NOVELS**

Researcher: Instructor Mary D. Howland

A doctor turned writer, the contemporary American novelist Walker Percy has been much interested in existential philosophy since his confinement in a tuberculosis sanitarium in the early 1940's. In interviews and essays, Percy refers to Soren Kierkegaard, Martin Heidegger, Jean-Paul Sartre, and Gabriel Marcel among others who have helped to shape his thought. A study not only of the philosophical background--the ideas that help to form a writer's mind--but also of how individual concepts inform the writer's novels will indicate how the novelist transforms raw data into realized characters and situations. Some work has already been done on Percy's indebtedness to Kierkegaard, but there has been little exploration of the equally important influence of Gabriel Marcel's thought on Percy's novels.

In this study, the researcher will trace Percy's continuing interest in the concept of intersubjectivity through his five novels. Two central and interrelated concepts inform Marcel's thought. Men must be faithful to each other in order to establish community, and so Marcel stresses fidelity. The love that opens two subjects to each other in a relationship of fidelity is the foundation of intersubjectivity.

Since Percy shares a world view with Marcel and an understanding of man as wayfarer, a being whose life is always in the process of becoming, it is not surprising that he would take the time in his novels to explore fully one of Marcel's central concerns, the intersubjectivity realm.

INDEPENDENT RESEARCH

ENGLISH DEPARTMENT

An examination of Percy's use of intersubjectivity will throw light on the novels. Percy's protagonist move from a stage of alienation to an intersubjective bonding within which they are able to make the first faint movements toward God, the source of all love, hope, and fidelity. Each protagonist is free to choose alienation, cut off from intersubjectivity and from himself, lost in the everydayness that settles like a fog on his world. But he is also open to the possibility of grace, of communion with a significant other with whom he can emerge from his own ruins. In every novel it is the actualization or the possibility of intersubjectivity that makes the protagonist's salvation possible.

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**ALAN LERNER'S CAMELOT AND THE ARTHURIAN TRADITION.**

Researcher: Major Laurence W. Mazzeno, USA

Little critical attention has been given to Lerner's Camelot, most scholars dismissing it as purely "popular" work that capitalizes on perennial interest in the Arthurian legend. The researcher is completing a detailed analysis of the play to show exactly how Lerner uses the legend, and how his modifications actually enhance the legend for modern readers in some instances. A study of the play as a literary phenomenon also provides insight into the way in which the legend survives in, and affects, each generation who comes to learn of it.

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**ALFRED, LORD TENNYSON**

Researcher: Major Laurence W. Mazzeno, USA

The researcher has completed a brief study of the English poet Alfred Tennyson's life and achievements, and has written an analysis of several poems representative of Tennyson's entire canon in an effort to introduce the poet to undergraduate students.

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**INDEPENDENT RESEARCH**

**ENGLISH DEPARTMENT**

**GENERAL OF THE ARMY JOHN J. PERSHING AS CHIEF OF STAFF**

**Researcher:** Major Laurence W. Mazzeno, USA

Much has been written about General Pershing's accomplishments as leader of the U. S. forces against the Mexican bandit Pancho Villa, and of his role as commander of the American Expeditionary Force in World War I. Relatively little study has been done, however, of his years as Chief of Staff of the Army (1921-24). The researcher is investigating this period of Pershing's life, to determine the impact of the General on the Army both during the years in which he filled that post and in the years following his tenure as Chief of Staff.

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**MATTHEW ARNOLD AND JAMES BRYCE**

**Researchers:** Major Laurence W. Mazzeno, USA, and Professor Allen B. Lefkowitz

Correspondence from the nineteenth-century English poet and critic Matthew Arnold and James Bryce, political figure and later Ambassador to America, contained among Bryce's unpublished papers, provides new corroborating evidence that these two important figures were lifelong friends. The correspondence, hitherto unpublished, suggests that each may have influenced the other's views on a number of cultural matters. Since both published important books on America, an understanding of their relationship may provide insight into the ways in which each developed the ideas for his book. The researchers are completing a paper documenting the extent of Bryce and Arnold's friendship.

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**NIKOS KAZANTZAKIS**

**Researcher:** Major Laurence W. Mazzeno, USA

The researcher is completing a brief study of the Greek poet and novelist, focusing on Kazantzakis' achievements and examining the way in which his philosophical outlook is manifested in his later novels, especially The Last Temptation of Christ.

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INDEPENDENT RESEARCH

ENGLISH DEPARTMENT

SIR THOMAS MALORY

Researcher: Major Laurence W. Mazzeno, USA

The researcher has completed a brief study focusing on the controversy surrounding the identity of the author of the Morte Darthur, the fifteenth-century English Arthurian romance that has become a classic of the language. He has also written an assessment of Malory's achievement and examined the conflict of honor (a chivalric virtue) and goodness (a Christian virtue) that gives the Morte its tragic dimension.

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THE HISTORICAL NOVEL

Researcher: Major Laurence W. Mazzeno, USA

The researcher has completed a brief survey of the historical novel, focusing on the development of the genre and highlighting characteristics that typify this form of writing. An analysis of the popularity of the genre and of the relationship of fiction to history is also included.

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LIBERAL LEARNING IN A TECHNICAL CURRICULUM, A BIBLIOGRAPHY

Researcher: Ensign Mary C. Murphy, USNR

In the Spring of 1982, the English Department organized and held a national conference on teaching in the humanities and the sciences. The key-note speaker and the workshop directors used some of the books listed in this bibliography. These resources as well as the other books compiled will serve to further scholar's thinking about how the human brain works, how people learn, and how to integrate technology with the Liberal Arts.

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SAMUEL FOOTE

Researcher: Ensign Mary C. Murphy, USNR

This article presents a short biography, an achievement summary, and an analysis of representative plays of Foote.

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THE UNITED STATES NAVAL ACADEMY

Researcher: Ensign Mary C. Murphy, USNR

This article presents a general discussion of the United States Naval Academy and deals specifically with the Academy's overall goal: to develop morally, mentally, and physically fit naval officers.

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HEMINGWAY'S WOMEN'S MOVEMENT

Researcher: Associate Professor Charles J. Nolan, Jr.

Hemingway's troubles with women are legendary. Beginning with his quarrels with his mother and running throughout his relationships with his four wives and with others, Hemingway's sometimes public disagreements helped to create his popular image as woman-hater. As if biographical detail were not enough, stories like "The Short Happy Life of Francis Macomber," with its unforgettable depiction of five-letter Margot and, by extension, of all of American womanhood, worked to solidify the portrait. But for all the clamor, recently joined by feminist critics, there is another side to this major if troubled artist. Whatever his personal idiosyncrasies (and there were many), as a writer he saw more clearly than perhaps even he knew. Throughout his work up to the late thirties, there runs a strong sympathy for the plight of women, a sympathy that at one point, in fact, is expressed in contemporary rhetoric and rage.

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ON LEGALITIES AND LINGUISTICS: PLAIN LANGUAGE LEGISLATION

Researcher: Associate Professor Stephen M. Ross

Five states have passed laws requiring consumer contracts to be written in plain language. The standards used in these statutes vary from a broad (and rather subjective) "clear and coherent" standard to precise but restrictive itemized lists of traits "plain" language must possess. While the statutes may prove effective, it is likely that they will be so only in the letter of observance rather than in the spirit of clear communication. Statutory requirements are better anchored in a speech act theory of discourse, which takes into account the purposes of consumer contracts.

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THE AUTHOR-CREATOR AND THE DIVINE CREATOR: AN EXAMINATION OF  
CYMBELINE AND OUR MUTUAL FRIEND

Researcher: Assistant Professor David A. White

The researcher is developing into an article for publication one chapter from his dissertation, "'Amazed With Matter': An Examination of Shakespeare's Innovative Techniques in Cymbeline Via Mozart, Dickens, and Shaw." The article will examine the parallels between the author's vision of himself as creator in his artistic world and the nature of the Divine Creator and his attitude toward his created world. The focal point of the study are Shakespeare's use of the god Jupiter in Cymbeline and his manipulation of the action and Charles Dickens' use of the narrator in his final novel, Our Mutual Friend, as a figure that intrudes into the action to aid his created characters.

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FROM PURGATORY TO THE PARADISE OF FOOLS: DANTE, ARIOSTO, AND MILTON

Researcher: Assistant Professor John Wooten

Most editors and commentators have assumed, and with good reason, that Milton's Limbo in Book III of Paradise Lost functions in some way as a literary allusion to Dante's first circle of Hell, which is Dante's Limbo. Dante is relevant, though not in so simple a way as critics have believed. In addition, critics and commentators have assumed — because of Milton's reference in the Limbo passage to the canto in Ariosto's Orlando Furioso where Astolfo, the English knight-errant, flies to the moon — that Milton has Ariosto very much in mind as a complementary source. Milton uses Ariosto, even "corrects" him, a strategy that also involves a correction of Dante, and of Dante's Purgatorio in particular. What we have in Milton's Paradise of Fools, his Limbo, is a very sophisticated piece of literary and theological criticism. Through the filter of Ariosto's moon fantasy, which in its turn is literary and theological parody of Dante's Commedia, Milton achieves a masterly double aim: to borrow some of Ariosto's comic-satiric thunder while striking at the same large satiric target: Dante's great medieval poem, especially the middle part of it.

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MILTON AND ITALIAN BURLESQUE POETS

Researcher: Assistant Professor John Wooten

Milton, much more than has been acknowledged, was influenced by the vogue for burlesque poetry which reached its zenith of popularity in England in his lifetime. Milton scholarship has rediscovered Milton's sense of humor, a facet of his personality lost for a while in overly sober assumption about the Puritan poet and classicist. But there is still more work to be done in order to demonstrate that Milton's classicism, even as it shaped Paradise Lost, was a flexible Renaissance classicism that allowed for a variety of manner that included burlesque debunking. Milton's admiration for and readiness to respond to things Italian help to explain his receptivity to burlesque, for the roots of Renaissance burlesque are Italian. In particular, Milton knew the comic burlesque poetry of Luigi Pulcu (1431-1487), Twofilo Folengo (1496-1544), and Alessandro Tassoni (1565-1635). Passages from these poets' works shed light on certain passages in Paradise Lost.

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SIR HENRY WOTTON

Researcher: Assistant Professor John Wooten

The researcher has undertaken a biographical-critical essay on the seventeenth-century poet and diplomat Sir Henry Wotton. The essay will give pertinent bibliographical information about editions, collections, and criticism of Wotton's poetry. In addition, a section will analyze Wotton's literary achievement; another will briefly describe his life; while a more extended section will analyze particular poems in an effort to make very specific the nature of his poetic talent.

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## THE CONFLICT OF POWER BETWEEN PENELOPE AND TELEMACHUS

Researcher: Assistant Professor Mallory Young

Telemachus' struggle to gain independence from his protective mother is immediately obvious in the Odyssey. What is less obvious, but equally important, is another struggle involving the same two actors--a struggle for power. The presence of this conflict helps to answer the puzzling question of Penelope's intended marriage. Penelope tolerates the suitors because she is considering marriage: and not only out of a desire for companionship or submission to flattery. If Odysseus does not return soon and Penelope does not remarry, she will lose her status and position--to her son and the woman he chooses as a wife. Many otherwise enigmatic interchanges between mother and son become clear in the light of this understanding. Odysseus' return restores the balance of power: Penelope will keep her place, Telemachus will wait his turn.

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## THE PHAEACIANS: PLEASURE, POETRY, AND TRAGIC CHOICE

Researcher: Assistant Professor Mallory Young

The decision of the Phaeacians to convey Odysseus to his home in Ithaca is one of the most problematical events in the Odyssey. The Phaeacians are well aware of the conflict between Poseidon and Odysseus: their guest has revealed it in his own story. They also know the dangerous consequences of aiding and abetting this wanderer. Numerous explanations have been offered to justify their action--forgetfulness, hospitality, even cowardice. But a better answer may appear in a consideration of the Phaeacians' own position and culture.

The Phaeacians live in a world of failing abundance, free from effort and toil. Their play-oriented culture represents the height of civilization. They live the life of the gods, separated from all men. Their view of storytelling corresponds: the bard Demodocus provides them with pleasure. But the Phaeacians are not gods; they are mortal. Odysseus' story forces them to a recognition of their own humanity. No one can stand disinterested between gods and men; the Phaeacians enter the struggle on the side of man, choosing their own mortality--much as had Odysseus himself on the island of Calypso. The Odyssey reveals that men are not gods--and that poetry is not solely an instrument of pleasure.

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PUBLICATIONS

ENGLISH DEPARTMENT

GILLILAND, C. Herbert, Lieutenant Commander, USNR, "Ebusus: An Old Mystery Revived," SAN: Journal of the Society for Ancient Numismatics, 12 (Spring, 1981), 4-5.

This article confirms the existence of a coin type reported in 1837, and speculated on its being a produce of Punic Ebusus. In 1837 the Marquis de Legoy described and illustrated an ancient coin which he assigned to the city of Massalia (Marseille). In 1870 Aloiss Heiss pointed out the resemblance of its reverse design to coins then believed to have come from the Phoenicians of Minorca, and suggested the coin might be evidence of an alliance between Minorca and Massalia. However, he was unable to locate any specimen to confirm that the coin really existed or that Legoy's description was accurate. Now, a newly-discovered specimen confirms that the coin exists and that Legoy was for the most part accurate. However, the coin has no connection with Minorca, and probably none with Massalia; rather, it may be the product of Punic Ebusus.

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MAZZENO, Laurence W., Major, USA, "Idylls of the King in 1981," The Arnoldian: A Review of Mid-Victorian Culture, 9, (Spring 1982), 48-62.

The publication of J. M. Gray's 'The Vision of the Night' (Edinburgh, 1982), adds to a growing list of books and articles that continue to investigate the critical controversies surrounding Tennyson's Arthurian poem. In this article, a history of that controversy is examined in detail, and the major critical positions regarding the poem are identified. Gray's contributions to the body of that criticism are reviewed and evaluated.

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MAZZENO, Laurence W., Major, USA, "Index" to William Strunk and E. B. White, Elements of Style, 3rd. ed. revised, (New York: Macmillan, 1982), pp. 87-92.

For years, Strunk and White's Elements of Style has been a standard text for teaching English style and usage. But the absence of an index has limited its use. This new Index provides citations for every form of usage discussed in the text and cross-references them when appropriate.

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NOLAN, Charles J., Jr., Associate Professor, Contributions to the Annual Bibliography of English Language and Literature, Volume 53, eds. Michael Smith, James B. Misenheimer, Jr., and Mary Jean DeMarr. Leeds: Modern Humanities Research Association, 1981.

Contribution to the Annual Bibliography come from a careful review of the many issues of fourteen journals ranging from Anthropological Linguistics to the International Philosophical Quarterly. The contributor examines and notes any article, edition, book, or thesis, published in any language, that has an important link to English or American language or literature and any ancillary work that bears significantly on those fields. Using a specialized format, he then prepares bibliography cards for such items and forwards them to the American editor, who in turn send the American contribution to Leeds, England, where the Annual Bibliography is published. The result each year is one of the two major bibliographies in English studies.

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NOLAN, Charles J., Jr., Associate Professor, "Freshman English Against Itself," The Journal of General Education, 33 (1981), 219-225.

Though the teaching of writing has at last become a legitimate enterprise, its emergence has led in many colleges to the elimination of literature from the freshman course. The reasons for this colossal blunder are several: a misinterpretation of the English Department's service function, the pressure of vocationalism, and the writing teacher's new-found prestige. The effects of removing literature, however, are none too good. One of the more misguided results has been the focus on mere skill acquisition; another has been a change in attitude toward both the course and the students. But most damaging has been the failure to develop literacy in the larger sense. Though the need to cultivate this larger literacy is a principal reason for reintroducing literature, there are others. Since students, as research shows, continue to read books after they graduate, English teachers should aid them in forming some sense of how to judge literature while they are in school. Another reason involves helping students make connections between past and present. Most important, however, the study of literature is essential if students are to become more civilized citizens.

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PARKER, Michael P., Assistant Professor, "Orpheus, 'small poet' Will, and the Making of Davenatus Virbius," Renaissance Papers, (March 1982), 1-12.

Alone among the poets practicing at court during the Caroline period, Sir William Davenant espouses a vatic conception of the poet's role. A near-death experience in the early 1630's spurred Davenant to parallel his own life with that of Orpheus, the mythical bard who descended into Hades but returned to tell the tale. The Orphic persona allows Davenant to legitimize his own tenuous position as a court poet and provides a model that enables him to come to grips with his unhappy personal and professional life. The poems collected in Madagascar (1638) record Davenant's claims to vatic power, as well as his self-doubts and fear of hostile critics, within a mythic landscape and an Orphic frame. With the attainment of a pension and a recognized position at court at the close of the decade, the poet outgrows the Orphic persona and moves on to new models to describe his vocation.

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PROTHRO, Nancy, Assistant Professor, co-editor, The Secret in Its Rocking Chair. Missoula, Montana: Montana Arts Council, 1981.

This book is a collection of creative writings by students and teachers in the Montana public schools, written during their participation in the Arts Council's Poet-in-the-Schools program. They include poems modeled after great poems ("Thirteen Ways of Looking at a Blackbird" by Wallace Stevens becomes, for example, "Thirteen Ways of Understanding Calculus") or poems based on memories, and poems using figurative language as their most important element.

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ROSS, Stephen M., Associate Professor, "The Evocation of Voice in Absalom, Absalom!" Essays in Literature, 8(Fall 1981), 135-150.

Voice in Absalom, Absalom! is problematic because narrative voices are highly ornate and rhetorical -- and thus intrusive--yet in order to evoke his fictional world Faulkner must make voices vanish in favor of scene. How this is achieved, or not achieved, gives the novel much of its power.

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SOLLEY, George C., Captain, USMC, and Eric STEINBAUGH, Major, USMC, ed. Moods of the Sea: Masterworks of Sea Poetry. Annapolis: Naval Institute Press, 1981.

This is a collection of over 200 poems associated with the sea. The anthology is intended, not only for the general reader, but also for classroom use in a Literature of the Sea course, such as is taught at the Naval Academy. However, the editorial apparatus (notes, comments) are kept to the bare minimum, and the selection of poems is rich and various, resulting in a book that could appeal to the more general public.

The poems are grouped into six sections according to predominant theme: (1) the physical sea and its creatures; (2) man's relation to the sea; (3) narrative; (4) humor; (5) legends and the supernatural; (6) use of the sea as metaphor. Within each section, the poems are in chronological order. The poems are essentially by English-speaking authors, although a few works important to the Western tradition are represented by translations recognized for value in their own right. It is intended that the book include the best sea poems of major writers; those sea poems indispensably well-known; and a rich variety of poems from different periods, of many different types, and by many different poets. To permit this variety, the only long poem printed in its entirety is The Rime of the Ancient Mariner; to avoid fragmentation only a very few other long works, of exceptional merit (e.g. Paradise Lost, Childe Harold's Pilgrimage, The Faerie Queen) are represented by excerpt. With these exceptions, the poems here collected are complete and of modest length. Poems in which the sea is mere background or is treated only incidentally are excluded.

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SOLLEY, George C., Captain, USMC, "Trust, Confidence, and Obligation," United States Naval Institute Proceedings, 107 (November 1981), 72-74.

This essay, awarded Second Honorable Mention in the Vincent Astor Essay Contest, focuses on the language of the officer's commission, with special attention to the abstract terms in the commission's second paragraph.

The officer's commission sets forth standards of performance that are absolute, strict, and demanding: the United States grants the commission with the full expectation that officers have certain high qualities, and the acceptance of that commission imposes a profound obligation on each new officer--without regard to how painful dangerous, or difficult it may be to fulfill.

The applicable meanings of such terms as trust, confidence, obligation, patriotism, valor, and fidelity are carefully defined. For example, a patriot is defined as one who disinterestedly (foregoing any personal gain) or self-sacrificingly exerts himself to promote the well-being of his country and who maintains and defends his country's freedom and rights.

If one recognizes and understands the depth and importance of the qualities required of an officer, and fully appreciates the vital nature of his entrusted mission, then he cannot help but feel an increased sense of obligation, a more powerful sense of duty.

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TOMLINSON, David O., Associate Professor, "A Publisher's Advice to Young Authors: John P. Kennedy and Peter H. Cruse Serve a Literary Apprenticeship," The Southern Literary Journal, 14 (Fall 1981), 56-71.

When John Pendleton Kennedy and Peter Hoffman Cruse began publishing the satirical Red Book in Baltimore in 1819, their identities as its authors were unknown both to the reading public and to their publisher. All the details of publication had to be handled by mail in order to preserve their anonymity. This article reproduces for the first time the texts of a dozen letters owned by the Peabody Library in Baltimore written to the young authors from their publisher. The letters deal with matters from the choosing of paper and type for the publication to reactions of the public to the pointed satire of the Red Book.

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TOMLINSON, David O., Associate Professor, "John Robinson Jeffers," Dictionary of American Biography, 1961-1965. New York: Charles Scribner's Sons, 1981, pp. 391-392.

This brief biographical sketch of the poet outlines his early training in languages under the tutlege of his father a Presbyterian minister and seminary professor, follows his difficulty in choosing a career for himself, reports his marriage to Una Lindsay Call Kuster, and follows his career as a poet. Jeffers causes a literary stir with his third book, Tamar and Other Poems (1924), a stir which culminated with predictions that he would be one of the greatest poets of his age. His high reputation as a poet waned in the mid-1940's, however. His verse translation of Medea (1946) received mixed reviews when it opened with Judith Anderson in the title role; but the production achieved fame.

PUBLICATIONS

ENGLISH DEPARTMENT

After 1954, Jeffers wrote little. He died in January 1962.

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TOMLINSON, David O., Associate Professor, "Kenneth Flexner Fearing," Dictionary of American Biography, 1961-1965. New York: Charles Scribner's Sons, 1981, pp. 239-240.

Fearing engaged in a variety of literary activities--writing for pulp magazines, publishing poems in magazines as prestigious as the New Yorker and Poetry, and editing radical publications. Fearing's own lifestyle was colorful enough to cause at least three novelists to use him as a character in their work between 1927 and 1933. His own proletarian poetry attracted notice because of its tough style, and he gained some reputation as a writer of mysteries, including The Big Clock (1946), a story made into a movie starring Ray Milland and Maureen O'Sullivan in 1948. Fearing died in New York on June 26, 1961.

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TOMLINSON, David O., Associate Professor, "Swallow Barn: A Sesquicentennial Celebration." Baltimore: Peabody Department of the Enoch Pratt Library, 1982.

This monograph serves for the exhibit brochure for the sesquicentennial display about John Pendleton Kennedy's book of fictional sketches, Swallow Barn. The display of more than one hundred manuscript items concerning the writing and publication of the book was sponsored by the Peabody Department of the Enoch Pratt Free Library and the Maryland Committee for the Humanities. The monograph includes a guide to the manuscripts included in the exhibition, a critical look at Swallow Barn and an outline of Kennedy's life. It also includes some of the illustrations drawn by David H. Strother (Porte Crayon) for the 1851 revised edition of Swallow Barn.

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**PRESENTATIONS**

**ENGLISH DEPARTMENT**

BERGMAN, Harriet F., Assistant Professor, "The Spinster Figure in American Literature," American Culture Convention, Louisville, Kentucky, April 1982.

JASON, Philip K., Associate Professor, "Poetry Reading," Montpelier Arts Center, September 1981; Gaithersburg (Maryland) Library, 18 March 1982.

JASON, Philip K., Associate Professor, "The Creative Writing Marketplace," University of Maryland, College Park, Maryland, April 1982.

JASON, Philip K., Associate Professor, "The Princess and the Frog: Anais Nin and Otto Rank," Modern Language Association, New York City, 28 December 1981.

JASON, Philip K., Associate Professor, "Writer's Dry Spell," Washington, D.C. Independent Writers, 1 April 1982.

LEFCOWITZ, Allan B., Professor, "Casting for the Sixth Annual Evelyn Le Brun Memorial First Play Contest, (original play), Writer's Center, Glen Echo, Maryland, (2 performances), November 1981; Georgetown University, Washington, D.C., (3 performances), December 1981.

LEFCOWITZ, Allan B., Professor, "Procrastination of the Writer," Washington, D.C. Independent Writers, 1 April 1982.

ROSS, Stephen M., Associate Professor, "Southern Oratory and the Dialogical in Absalom, Absalom!," Second Annual Faulkner Colloquium, Paris, France, 3 April 1982.

TINSLEY, Molly B., Assistant Professor, "Fiction Reading," Takoma Park (Maryland) Public Library, April 1982.

TOMLINSON, David O., Associate Professor, "An Investigation of the Fictional Techniques Used in Swallow Barn," Sesquicentennial Celebration of the Peabody Department of the Enoch Pratt Free Library, Baltimore, 28 May 1982.

TOMLINSON, David O., Associate Professor, "Fire and Wit in the Journals of John Pendleton Kennedy," Baltimore Bibliophiles, Evergreen House, Baltimore, 17 November 1981.

WOOTEN, John, Assistant Professor, "Milton and Violence," Spring Meeting of the Shakespeare and Renaissance Association of West Virginia, Morgantown, West Virginia, 16 April 1982.

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## HISTORY DEPARTMENT

*Professor Philip W. Warken, Chairman*



For the History Department, 1981-1982 was an outstanding year in publication and research. Two books were published and others revised. All were in the field of history. The faculty also published twenty-two articles, papers, and encyclopedia entries.

Throughout the year, the History Department continued to participate actively in professional conferences across the country. At fifteen of these, faculty members presented papers. Other presentations were made to military and civic audiences.

The results of the History Department's deep involvement in research are reflected in the ongoing enrichment of the classroom experience offered the midshipmen as well as in the production of scholarly publications and papers.

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## SIEGFRIED SASOON AND THE CRISIS OF MODERNITY IN THE GREAT WAR

Researcher: Assistant Professor Theodore Bogacz

Sponsor: Naval Academy Research Council

The project is a study of the English poets of the First World War as representative figures of the generation of 1914. Siegfried Sassoon and other gentlemen-officers were no isolated aesthetes, but the most articulate spokesmen for a generation undergoing a crisis of modernization as a result of their service on the Western Front. Sassoon exemplifies a radical shift in consciousness. Also, Sassoon, the most successful surviving poet of the Great War, befriended and influenced the most significant English war poets. The Western Front provided a kind of "baptism" into modernity. Resolutely opposed before 1914 to "modern" trends, Sassoon and his friends entered the war to restore traditional values. Ironically, the war turned into a democratic mass industrial war. Sassoon and other poets were forced to confront and adapt to the very forces they had opposed before the war. They encountered three major crises in language, in politics, and in psychology. They were national crises experienced by soldiers in the trenches and civilians on the homefront alike.

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MEDALISTS AND MUTINEERS: A TEST OF SOCIAL-ORDER THEORY

Researcher: Lieutenant Commander James W. Williams, USNR

Sponsor: Naval Academy Research Council

This study tries to analyze some of the factors that create or permit social order in the military context. The records of Medal of Honor winners and people adjudged to have committed the crime of mutiny (or lesser-included offenses) are viewed as data on examples at the extremes on a scale of formally-evaluated behavior. Using this data, ideas about the power of coercion and self-interest as sources of social order are being tested.

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THE LIFE OF PHILIP H. SHERIDAN, 1831-1888

Researcher: Lieutenant Commander Roger T. Zeimet, USNR

Sponsor: Naval Academy Research Council

General Philip H. Sheridan was one of the most prominent military figures in the Civil War. Yet, despite that prominence, his life has never been the subject of a sound, in-depth scholarly biography. The purpose of this project is to fill that void.

In 1981 the researcher received a Ph.D. degree in history from Marquette University after completing a dissertation entitled "Philip H. Sheridan and the Civil War in the West" which covered Sheridan's life up to 1864. The current grant from the Naval Academy Research Council will provide seed money to begin research on the remainder of Sheridan's military career.

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HISTORY OF THE PUGET SOUND NAVAL SHIPYARD

Researcher: Professor William M. Belote

The purpose of this publication is to write a concise brief history of the Puget Sound Navy Yard located in Bremerton, Washington. This is to be a chapter in a book on U.S. Navy yards edited by P.E. Coletta and to be published by the Greenwood Press in 1983 or 1984. The length of the chapter will be approximately 6,000 words. Research materials were collected during the summer of 1981 while travelling in the area. Writing for the publication will begin soon.

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THE 'SHELL-SHOCK' CRISIS OF WORLD WAR I: THE ENGLISH CASE

Researcher: Assistant Professor Theodore Bogacz

This article will deal with the revolutionary impact of the hundreds of thousands of "shell-shock" casualties in 1914-1918 on the Army's, the Government's, and the English public's attitudes toward psychology and mental illness. The text begins by briefly describing the terrifying conditions on the Western Front which drove so many soldiers into nervous collapse. How the massive incidence of shell-shock in World War I affected the British Army from battalion medical officers to the General Staff will also be discussed. Through this work it will be demonstrated that shell-shock, regarded in 1914-15 as an excuse for cowardice (when recognized at all), by the end of the war was being treated with a surprising degree of sophistication by Army authorities. Turning to civilian responses to the shell-shock phenomenon, the ignorance and hostility which in 1914 characterized the educated public's attitudes toward psychology and mental illness will be stressed. By 1918, the English national press reflected a vast shift of attitudes: the Times, for example, was advancing complex psychological theories to explain shell-shock and was now casually employing the once-recondite language of Freudian analysis in its columns.

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**AMERICAN NAVAL BASES IN LATIN AMERICAN WATERS, 1860-1980**

Researcher: Professor William Calderhead

The purpose of this project is to do a study of about three dozen U.S. Naval bases that have been set up in the area of Latin America between 1860 and the present. This will comprise part of a larger study (performed by other historians) for a book, edited by Paolo Coletta, that will deal with the theme of American bases around the world, in peace and in war.

Background work involves researching information about such activities for Latin America. Material is being used in the Navy files of Nimitz Library, the library at the Navy Yard in Washington, and at the various divisions of the Library of Congress. The finished product will consist of a discussion of naval base acquisition, organized on a geographical basis but with chronological coverage of each base's growth and decline.

The project will involve full time effort through the summer of 1982 and will be completed by September 1982.

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**THE GREY EMINENCE: A BIOGRAPHY OF CYRUS R. VANCE AS SECRETARY OF STATE**

Researcher: Professor Paolo Coletta

This project is the research and writing of a biography of former Secretary of State Cyrus R. Vance dealing particularly with how he handled crises involved with the Panama Canal treaties, Somoza in Nicaragua, SALT, and Iran. Research is in progress.

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**U. S. NAVAL BASES**

Researcher: Professor Paolo Coletta

The researcher is contributing editor for Greenwood Press to a two-volume study of naval and naval aviation facilities that have supported the fleet. The proposed study will be published in 1983.

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## NAVAL WARFARE ON THE WESTERN FRONTS IN WORLD WAR I

Researcher: Professor Paolo Coletta

Using Italian and French as well as English-language sources, this work seeks to tell the story of naval actions of the British, French, Germans, Italians, and Austro-Hungarians in the North Sea, Atlantic, Mediterranean, and Adriatic Seas.

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## WOMEN IN THE ROMAN EMPIRE

Researcher: Assistant Professor Phyllis Culham

In order to present to an international, scholarly audience a Forschungsberichtz on the current status and nature of research on women in the Roman Empire, a survey of all available literature in all major European languages using resources of Johns Hopkins University and Library of Congress is being made. The literature survey is just about 90% complete; no draft has been started. The result will be approximately one hundred typescript pages to be published in Supplementband of Aufstieg.

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## WAR ON THE RIVERS: THE FRANKISH MILITARY RESPONSE TO THE NORSE INVASIONS IN WEST FRANCIA

Researcher: Assistant Professor Carroll Gillmor

The purpose of this study is to provide an in-depth analysis of the logistical problems which confronted both Northmen and Franks in the ninth century. The introduction places the study in the context of logistics in military historiography, and then moves on to the first two chapters which examine the logistical capabilities and difficulties of the Northmen and the Franks on the Seine and the Loire Rivers. Inexperienced in riverine warfare the early operations (845-862) developed an effective tactical doctrine to stop the Norse advance. The fortified bridge which effectively deterred a Norse retreat on the Marne in 862, became the Frankish tactical deterrent against the Northmen. Under the direction of the Frankish King (Charles the Bald) an extensive construction project was undertaken on the Seine. Fortified bridges appeared at key strategic locations, especially where major tributaries flowed into the Seine. The logistics at bridge construction, the mobilization of workers and the transport of building materials to the sites, comprise the body of the work. The expansion of the fortified bridge concept into the Loire basin enabled the Franks to develop an integrated riverine defense

system which was capable of withstanding simultaneous attacks of Northmen on both rivers. War on the rivers provides an example of how a tactical idea develops into a tactical doctrine and finally merges into a strategy.

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THE WARTIME DIARY OF GENERAL H. H. ARNOLD

Researcher: Professor John Huston

This is an attempt to edit the twelve chapters of a diary kept by General Arnold during World War II. The editor is providing commentary and introduction to each chapter along with normal editorial identifications of people, places, and events. The aim is for commercial publication.

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U. S. FOREIGN POLICY AND ORIGIN OF THE COLD WAR IN EUROPE,  
1945-1951

Researchers: Associate Professor Robert W. Love, Jr., and  
Midshipman 2/C Darrell B. Montgomery

This project was undertaken in preparation for a Trident Project in 1982-1983. The purpose was to acquaint the student with all of the secondary and published primary sources on U.S. Naval policy from the close of World War II to the creation of SHAPE in 1951.

The project consisted of a series of written analyses of the major interpretation of the origins of the Cold War and the involvement of the U. S. Navy in formulating strategic plans to support American foreign policy. The student concluded that most naval historians have been so intrigued by the unification crisis that they have ignored the Navy's role in Atlantic/European strategy, the formation of the NATO alliance, and the creation of a NATO naval command under Admiral Fechteler in 1950.

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ANGLO-AMERICAN NAVAL DIPLOMACY AND THE BRITISH PACIFIC FLEET,  
1942-1945

Researcher: Associate Professor Robert W. Love, Jr.

Prior to World War II, the British planned to send a fleet to the Far East in case of war with Japan but this scheme was jettisoned in 1938 due to the threat of Germany. After Pearl

INDEPENDENT RESEARCH

HISTORY DEPARTMENT

Harbor, the British were ambivalent about the deployment of U.S. Navy forces to the Pacific, and they adamantly rejected American requests for diversionary operations prior to Midway and during the battle for Guadalcanal. By 1943 American naval forces in the Pacific were so large that Washington no longer wanted British assistance. Indeed, the Admiralty was committed until 1944 to the recapture of Singapore. Ironically, in the fall of 1944 the British decided that their interests were best served by operating in the Central Pacific, and they persuaded Roosevelt to accept their offer despite the intransigent opposition of Admiral King. Nonetheless, the British contribution to the Pacific campaign proved to be modest.

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**UNITED STATES NAVAL STATIONS IN LATIN AMERICA, 1790-1850**

Researcher: Assistant Professor Daniel M. Masterson

This study, which is part of an anthology being edited by Professor Paolo Coletta, will provide a descriptive guide to the naval stations utilized by the United States Navy in Latin America during the early decades of the 19th Century.

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**POLITICS AND MILITARY PROFESSIONALISM IN PERU, 1939-1963**

Researcher: Assistant Professor Daniel M. Masterson

This book-length study will examine the antecedents of the anti-civilian, reformist ideology which characterized the ideology of the radical military activists who dramatically altered Peruvian social and political institutions in the decade after 1968. It employs Peruvian armed forces and civilian records as well as U.S. archival materials and personal interviews as well as all current secondary material related to the question of civil-military relations in Peru. When completed, it will provide the only study available in English of Peruvian civil-military relations in this period.

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## APRA AND THE PERUVIAN MILITARY, 1948-1968

Researcher: Assistant Professor Daniel M. Masterson

This study continues work begun under a NARC grant last year. It involves analyzing the relationship between Peru's leading party of the Left, the Alianza Popular Revolucionaria Americana (APRA) and the armed forces in the two decades after 1948. Its particular focus will be the military leadership's dealings with APRA chief Victor Raul Haya de la Torre.

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## THE ENCYCLOPEDIA OF U.S. NAVY AND MARINE CORPS HISTORY

Researchers: Assistant Professor Jack Sweetman and  
Associate Professor Kenneth J. Hagan

This work has been conceived to remedy the lack of a single, "one-stop" coverage to which the student or researcher can turn for coverage of all important aspects of U.S. Navy and Marine Corps history. Alphabetically organized, it will consist of approximately 1500-2000 entries, combining the operational, administrative, biographical and technological threads of American naval history. In terms of content, the entries will be of two types: brief, purely factual entries on specific subjects and longer, analytical entries on topical areas. The work should prove an invaluable reference to anyone involved in American naval history. A contract for publication has been signed with the U.S. Naval Institute. The expected completion date is summer 1983.

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## WILLIAM S. BAINBRIDGE

Researcher: Associate Professor Craig L. Symonds

In the pantheon of American naval heroes, the figure of William S. Bainbridge is one that most naval historians pass over quickly, perhaps in some embarrassment. True, he did win a bloody slug fest with a British frigate and return home a hero in 1812, but "Hard Luck Bill," as at least one prominent authority labels him, is more often remembered for his blunders. He was the first American captain to surrender a ship in the Quasi-War in 1798 and he did so without firing a shot. In another war he ran the frigate Philadelphia aground in broad daylight on a hostile shore and lost both the ship and the crew to the enemy, thus reversing at a single stroke the balance of power in the Mediterranean.

This study explores Bainbridge's life and career and concludes that Bainbridge's own limitations as a naval officer, particularly his inability to see beyond the letter of his official instructions, contributed to his "hard luck."

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CAPTAIN BENJAMIN F. BROWN--HERO OR VILLAIN? A CASE STUDY FROM THE CIVIL WAR

Researcher: Lieutenant Commander James W. Williams, USNR

This study uses historical data to look at one facet of problems inherent in the process of classifying data to create an evaluation. The wide range of variation acceptable in the classification of identical conduct according to incidental, environmental factors creates the possibility of having the same conduct evaluated at the extremes of a scale within a short period of time. The dishonorable discharge of an Army captain who, as part of his duties, tried to prosecute men in his unit who lynched a Black cook during the Civil War reveals such a set of conditions and the way they can operate to produce unhappy results for the individual and, perhaps, the organization.

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NEW MILITARISM? -- THE VIETNAM MEMORIAL CONTROVERSY AS A TEST CASE

Researcher: Lieutenant Commander James W. Williams, USNR

The controversy over the design for the Vietnam memorial to be built in Washington, D.C., allows some valuable insights into whatever relationships exist between "militarism" and the humanities in contemporary American society.

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INDEPENDENT RESEARCH

HISTORY DEPARTMENT

**GENERAL BEN H. FULLER**

Researcher: Lieutenant Commander Roger T. Zeimet, USNR

General Fuller was the 15th commandant of the Marine Corps. The purpose of this project is to provide a biographical chapter on his military career that will be incorporated into a general anthology on the commandants of the Marine Corps which the Naval Institute will be publishing in 1983.

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**OVERSEAS MARINE CORPS BASES**

Researcher: Lieutenant Commander Roger T. Zeimet, USNR

This project is designed to provide a chapter for incorporation into an anthology entitled United States Naval Bases: A Historical Encyclopedia to be published by Greenwood Press.

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**THE DEVELOPMENT OF THE POPULARES PARTY IN THE LAST GENERATION OF ROMAN REPUBLIC****Researcher:** Midshipman 1/C Thomas L. Reese**Adviser:** Assistant Professor Phyllis Culham

The Roman Republic possessed one of the most elaborate political systems in antiquity. Ruling under the guise of a republican form of government, a small, oligarchic group of nobles controlled the upper echelons of the political power structure, and they jealously guarded that position from any persons outside of their elitist sphere. The senators were not, however, a unified political entity, for factions quickly developed within the hierarchy. The trend of modern historical interpretation has been to assume that these factions never formed into an opposing party in the political system, but remained a subversive element of the ruling Optimates Party. The paper attempts to prove that a political counterforce, the Populares Party, developed in Rome during the last generation of the republic.

Concentrating on the political careers of Caesar, Crassus, and Pompey, many similarities can be traced in their respective ascents to power. Those similarities are used to illustrate the common elements of the Populares Party. The major characteristic of the party was its bypassing of the established Optimates' political rules through direct appeals to the people for their support. By carefully studying the sources of Cicero, Plutarch, and Appian, the political trends can be easily found.

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**THE DEMOCRATIC ROOTS OF ATHENIAN IMPERIALISM IN THE FIFTH CENTURY B.C.****Researcher:** Midshipman 1/C Timothy J. Galpin**Adviser:** Assistant Professor Phyllis Culham

Although the primary values of Athenian democracy, isegoria, isonomia, and koinonia, all imply political freedom and equality before the law, the Athenians willingly acquired an empire in which the subjects faced both limited political freedom and inequality before the law. There was, of course, some controversy in the Athenian political arena over imperialistic policies, and even over the democracy itself, but there seems to have been a strong consensus supporting both. Despite an apparent contradiction between empire and democracy, the Athenian ethical system did not preclude rule over others; rather, the

'radical' democracy of Athens required imperialism for both ideological fulfillment and the establishment of certain characteristic institutions. Indeed, for the Athenians, the imperial precept of rule over others actually derived from the principles of freedom and equality.

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#### AMERICAN PERCEPTIONS OF THE SOCIALIST OPPOSITION TO THE PROVISIONAL GOVERNMENT IN RUSSIA, 1917

Researcher: Midshipman 2/C Robert G. Papp

Adviser: Associate Professor Jane E. Good

The purpose of this paper is to examine American knowledge and analysis of the rise of socialism during the period March-November, 1917, in Russia. In this period, the United States publicly and financially supported the Provisional Government. This temporary government was the experiment we believed would lead to democracy in Russia, and its success would determine if Russia would stay in the war. A considerable amount of information was available and reported to Americans about socialist opposition. Did America realize that the government would ultimately fail? Did she objectively look at the information, or follow preconceived ideas in spite of what was being heard? Finally, given the many reports received in the United States, who did we give credence to, and should we have been more open-minded? These questions are important in any analysis of foreign events, and are applicable today.

In Russia, the period was a crucial one. Immediately, the course of World War I was at stake. In grander terms, the course of Russian History was irrevocably changed, as the Soviet Union emerged from the ruins of Russia in 1917.

The paper is treated from a topical standpoint, examining distinct areas of American perception of Russian socialist opposition. The paper is kept chronological insofar as the topics permit. The intent is to prove that many Americans knew what was happening in Russia, but that the information was incomplete, and we followed our course with the Provisional Government in spite of this knowledge. We believed what we wanted to believe, and acted accordingly. The United States government acted in the hopes that democratic Russia would prosecute the war as long as possible.

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**THE ORIGINS AND DEVELOPMENT OF THE COLD WAR**

Researcher: Midshipman 2/C Darrell B. Montgomery

Adviser: Associate Professor Robert W. Love, Jr.

During the Spring 1982 semester, the origins of the Cold War were studied using primary and secondary sources available at Nimitz Library and other material provided by the adviser. The researcher was not pushed to accept one model, but rather studies the views of several historians to gain a new perspective on the period.

After completing each of the document sets or books assigned, a discussion period took place during which the major points of each author were reviewed. In addition to this, a one-page, single-spaced, typed review of each item or monograph was prepared highlighting the major strengths and weaknesses of the arguments.

By the end of the semester, it was realized that there are no simple answers as to why the Cold War developed; it was not only the "fault" of one side, but a combination of elegant and intertwined factors. Though revisionists have stressed the economic side of the argument, they tend to leave out other pertinent issues. For example, public opinion strongly affected American foreign policy during this tense period; so did Joseph Stalin by his efforts to secure Russia's western frontier.

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PUBLICATIONS

HISTORY DEPARTMENT

BARTLETT, Merrill, Lieutenant Colonel, "Lejeune as a Midshipman," Marine Corps Gazette, 66 (May 1982), 73-79.

Lejeune was the most famous commandant of the Marine Corps (1920-1929). He began his naval career at the U. S. Naval Academy in 1884. Although near the top of his class academically and professionally, Navy officials attempted to block Lejeune's request to be commissioned in the Marine Corps. Lejeune was apparently not attracted to the Corps for any particular reason, but was repulsed by life at sea.

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BARTLETT, Merrill, Lieutenant Colonel, "Cruise of the Iroquois," U. S. Naval Institute Proceedings, 107 (November 1981), 128-129.

Second Lieutenant George Barnett was serving as the commander of the Marine guard in the Iroquois, a converted sloop-of-war typical of the late 19th century navy. Enroute from Hawaii to Samoa, a broken piston rod caused the captain to hoist sail; however, because it was dragging a huge propeller through the water, the Iroquois tended to drift to the West, preventing their return to Honolulu. Thus the Iroquois drifted to Washington state. In the process of this arduous voyage, the crew almost perished. Later, Barnett served as the Commandant of the Marine Corps (1914-1920). Another future Commandant was also aboard, Naval Cadet Ben H. Fuller (1930-1934).

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BELOTE, William M., Professor, contributing editor, Sea Power: A Naval History, E. B. Potter, editor, Annapolis: Naval Institute Press 1981.

The researcher condensed three chapters into one concerning the Atlantic phases of the History of World War II less the Battle of the Atlantic as requested by the editor, E. B. Potter. This book was written expressly for the naval history course offered at the Naval Academy, and was adopted as an organizational text this past term.

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CALDERHEAD, William L., Professor, "Prelude to Yorktown: A Critical Week in a Major Campaign," Maryland Historical Magazine, 77 (June 1982) 123-135.

The article deals with the time factor that Washington had to contend with as he moved his army south through Maryland for the War's last major campaign.

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COLETTA, Paolo E., Professor, "A Question of Alternatives: Wilson, Bryan, Lansing, and America's Intervention in World War I," Nebraska History, 63 (Spring 1982) 33-57

Bryan suggested that Wilson offer to mediate between the belligerents in September 1914, without success, and Wilson listened more to others who favored the Allies. Bryan would hold both belligerent camps responsible for violations of U.S. neutrality, whereas Wilson and Lansing (Counselor of the State Department), evaluated the German U-boat warfare as a greater violation of the freedom of the seas than Britain's strangulation blockade of the Central Powers. Bryan opposed loans to belligerents; Lansing persuaded Wilson to extend credits, thereby helping the Allies. Bryan would bar armed Allied merchant ships from American harbors; Lansing persuaded Wilson that such ships were merely armed defensively. Contrary to some historians' opinions, Bryan agreed with Wilson and Lansing to oppose an arms embargo. On this point the administration helped insure American prosperity but lost an excellent weapon with which to bludgeon the Allies into respecting America's neutral rights. Bryan would have Americans travel on belligerent ships only at their own risk or ban such travel altogether, but Wilson stuck by the freedom of the seas. Wilson had the alternatives of forcing the British to abandon their practices through the use of naval power and an economic embargo or of acquiescing to them and by doing so indirectly to cooperate with them. Unable to win Wilson to his views, Bryan resigned on 8 June 1915 and from the stump sought to convince the American people not to go to war. Many of Bryan's ideas were used by the F. D. Roosevelt administration from 1935 to 1939 in an attempt to avoid having the United States enter World War II.

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GOOD, Jane E., Assistant Professor, "Pavel Nikolaevich Miliukov," Modern Encyclopedia of Russian and Soviet History (MERSH). Vol. 22, 1981, pp. 110-115.

This 3,500-word biography of Miliukov traces the life of this important leader of Russian liberalism. Research was conducted in Russian and English sources. The article contains an extensive bibliography of primary source materials about Miliukov and Russian liberalism.

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ISENBERG, Michael T., Commander, USNR, War on Film: the American Cinema and World War I, 1914-1941 (Rutherford, New Jersey: Associated University Presses, 1981).

Scholars have been slow to include mass communication phenomena as evidence in their examination of twentieth century America. A significant aspect of these phenomena is the motion picture. Films transmit ideas, attitudes, and values commonly held in a mass culture. The study of these ideas, attitudes, and values can prove rewarding to the historian.

This monograph is a study in the use of film as historical evidence. It is based on films and film scripts as well as on more traditional forms of evidence. The subject comprises those motion pictures that concerned the American World War I experience, although the focus could be on any historical topic that has both accumulated a considerable historiography and has been extensively treated on celluloid.

The study is divided into five sections, following an introductory chapter on the widespread popularity of film in the interwar period. Part One discusses in general the relationship between film and history. It provides a background for succeeding chapters by relegating aesthetic film criticism to a position of secondary importance and advocating traditional historical methodology as the most rewarding approach to the examination of history in film. Part Two discusses "factual" films of World War I, including documentaries, semi-documentaries, and newsreels. Part Three is concerned with the nature of the war as it appeared on American screens. Included are treatments of democracy and war, war-as-adventure, and war as a promoter of pacifism. Part Four is an analysis of the imagery of the war film as it concerned the enemy, the ally, and the American homefront. Part Five treats other varieties of the war experience. It included chapters on screen views of women in war and war humor. The whole is finished by a chapter-length conclusion.

While the historiography concerning the World War I period and its aftermath is in some instances sustained, the study indicates some revision of the assessment of national attitudes toward the war, at least those indicated on film. The war-as-adventure theme continued throughout the entire interwar period. Films of pacifism appeared in 1930, and continued to be produced down to 1939, but they never dominated the genre. American attitudes toward the American role in World War I seldom varied from the highly favorable. Ideas remained simplistic, and the value structures presented continued to be traditional, in contrast to the standard view of the twenties and thirties as a time of social and intellectual flux.

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MASTERSON, Daniel M., Associate Professor, "From Caudillos to Professional Soldiers: The Origins of Peru's Modern Armed Forces," The Red River Valley Historical Journal of World History, V (Spring 1981), 220-232.

This study examines the professional development of the armed forces in Peru from the advent of the French Army Mission in 1895 until the demise of the civilian autocrat, Augusto B. Leguia, in 1930. It is particularly concerned with the impact of French military training and theory upon the professional ideology of Peruvian army officers; but it also examines the beginnings of Peru's navy and air force.

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STRANGE, Joseph L., Assistant Professor, "The British Rejection of Operation SLEDGEHAMMER, An Alternative Motive," Military Affairs, 46 (February 1982), 6-14.

In the aftermath of the disastrous setbacks at Crete, Singapore and Tobruk 1941-1942, Winston Churchill doubted the ability of the British Army to conduct a credible military effort across the English Channel in the summer or fall of 1942. Had Churchill been forced by the threat of a reversal of the American Europe-first strategy to undertake Operation SLEDGEHAMMER (designed to secure a permanent bridgehead in France in 1942), he would have secretly welcomed another Dunkirk, which was a glorious episode compared to the disgrace associated with the fall of Crete and the surrenders at Singapore and Tobruk. These latter setbacks raised doubts about the morale of the British Army and its leadership to the point where Churchill and his senior military advisers questioned the ability of the British Army to achieve an "honorable defeat" across the Channel. The Prime Minister, of course, had several good reasons to reject SLEDGEHAMMER; this article adds one more to the list.

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PUBLICATIONS

HISTORY DEPARTMENT

SYMONDS, Craig L., Associate Professor, "Alfred Thayer Mahan," Maritime Strategy in the Nuclear Age, edited by Geoffrey Till. London: Macmillan, 1982, pp. 28-33.

In a general work that explored the validity of classical theorists of naval warfare and maritime power in the modern age, this essay offers the conclusion that A. T. Mahan was more a reflection of a view of naval power that had already become popular than he was an original or seminal thinker.

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SYMONDS, Craig L., Associate Professor, "The Yankee Mariner from the 17th to the 20th Centuries," The Yankee Mariner and Sea Power, Center for Study of American Experience. Los Angeles: University of Southern California Press, 1982, pp. 29-46.

This article surveys the American maritime heritage from the earliest colonial times to the first world war. It is an introduction to a broader and more intensive look at America's sea resources, including raw materials and trade as well as military uses of the sea. The paper was originally presented orally at a conference sponsored by the Annenberg School of Communication at the University of Southern California.

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SYMONDS, Craig L., Associate Professor, "Notable Naval Books of 1981," In U. S. Naval Institute Proceedings, 108 (January 1982), pp. 85-89.

This annual summary highlights the top fifteen to twenty naval and maritime books of the past year.

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PUBLICATIONS

HISTORY DEPARTMENT

WILLIAMS, James W., Lieutenant Commander, USNR "The Difference It Makes--Or Should Make; a Review of Feminist Criticisms of Feminist Criticism," Women's Classical Caucus Newsletter, 7 (Spring 1982), pp. 2-3.

This article reviews "A Feminist Perspective in the Academy: the Difference It Makes," a special issue of Soundings; an Interdisciplinary Journal 64 (Winter 1981), and Margrit Eichler, The Double Standard; a Feminist Critique of Feminist Social Science (New York, 1980). These publications seem to represent the state-of-the-art in feminist criticisms and allow some assessment to be made of what this type of criticism has and has not achieved. Common themes are found: feminists claim to recognize several types of inequalities in society beyond the commonly-accepted ones of wealth, status, and power. Feminist scholars provide an alternative viewpoint and data to support it that could transform society. Overall, however, the overwhelming fact to date is the marginal impact of feminist studies, either within or outside the academy. These findings suggest that, to remain vital in the future, scholarship must nourish or at least accept the persistence of interdisciplinary studies.

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PRESENTATIONS

HISTORY DEPARTMENT

ARTIGIANI, P. Robert, Associate Professor, "Tablet and Tool: An Essay On Technology and Human Values," Humanities and Technology Association Fifth National Conference, Atlanta, Georgia, 23 October 1981.

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ARTIGIANI, P. Robert, Associate Professor, "History and Future of the Seaplane," Airplane Owners and Pilots Association, Arlington, Virginia, June, 1981.

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BARTLETT, Merrill, Lieutenant Colonel, USMC, "The Age of FDR," Smithsonian Institute, Washington, D.C., February 1982.

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BOGACZ, Theodore, Assistant Professor, "From the Crystal Palace to the Bauhaus," National Association for Humanities Education Conference, Columbus, Ohio, 24 October 1981.

\*\*\*\*\*

BOGACZ, Theodore, Assistant Professor, "'A Very Strong Anti-War Complex': Siegfried Sassoon, W. H. R. Rivers, and the Crisis of Shell-Shock in World War I," Washington Society for the History of Medicine, Bethesda, Maryland, 12, November 1981.

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CALDERHEAD, William L., Professor, "Inadequate Security Jeopardizes a Major Campaign: The British Army in Philadelphia, 1777," Rocky Mountain Conference on British Studies, November, 1981.

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CALDERHEAD, William L., Professor, "Prominent Black Families in Maryland in the 19th Century," Maryland Commission on Afro-American History, Annapolis, Maryland, 25 February 1982.

\*\*\*\*\*

DARDEN, William M., Associate Professor, "Annapolis During the Civil War," St. Johns College, Annapolis, 19 January 1982.

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PRESENTATIONS

HISTORY DEPARTMENT

GILLMOR, Carroll, Assistant Professor, "The Impact of Cavalry on Medieval Warfare and Institutions," Mid-America Medieval Association, Little Rock, Arkansas, 6 March 1982.

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GOOD, Jane E., Assistant Professor, (Commentator and Participant), "The Two German States in Modern History and Politics," Europaische Akademie Berlin, Berlin, Federal Republic of Germany, 29 June-4 July 1981.

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GOOD, Jane E., Assistant Professor, "American Sympathy for Russian Revolutionaries; Kennan, Stepniak and the Friends of Russian Freedom," 20th Annual Meeting, Southern Conference on Slavic Studies, Lexington, Kentucky, 22 October 1981.

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HAGAN, Kenneth J., Associate Professor, "A History of American Naval Strategy," The Center for Naval Analyses, Arlington, Virginia, Fall, 1981.

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HARROD, Frederick S., Associate Professor, "Enlisted Men in the U.S. Navy," Staff of National Archives, Washington, D.C., November 1981.

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HUSTON, John W., Professor, "8th Air Force vs the Luftwaffe," Eighth Air Force Historical Society meeting, Minneapolis, Minnesota, October 1981.

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HUSTON, John W., Professor, "USAAF-RAF Cooperation in World War II, RAF Cranwell student Body, Cranwell, England, February 1982.

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HUSTON, John W., Professor, "Case Study in Air Leadership: H. H. Arnold," Air War College, Maxwell Air Force Base, Alabama, August 1981.

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HUSTON, John W., Professor, "Leadership in World War II, Arnold, Spaatz, Airmen," Air Command and Staff College, Alabama, September 1981.

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PRESENTATIONS

ECONOMICS DEPARTMENT

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HUSTON, John W., Professor, "Leadership and the USAF--A Case Study," USAFE Leadership School, Wethersfield AFB, Essex, England, February 1982.

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HUSTON, John W., Professor, "The President's Visit Annapolis," St. John's Lecture Series, St. John's College, Annapolis, February 1982.

\*\*\*\*\*

NALLE, Sarah T., Assistant Professor, "The Unknown Reader: Women and Literacy in Golden Age Spain," The Fifth Berkshire Conference on the History of Women, Vassar College, New York, June 1981.

\*\*\*\*\*

STRANGE, Joseph L., Assistant Professor, "The British Defenders of Operation SLEDGEHAMMER, The Cherbourg Alternative," Missouri Valley History Conference, Omaha, Nebraska, March 12, 1982.

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STRANGE, Joseph L., Assistant Professor, "Island Hopping in the Pacific, World War II," Montgomery College, Rockville, Maryland, 11 February 1982.

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STRANGE, Joseph L., Assistant Professor, "The Mysteries of Pearl Harbor," Montgomery College, Rockville, Maryland, 25 March 1982.

\*\*\*\*\*

SWEETMAN, Jack, Assistant Professor, "History of the French Legion of Honor," Banquet address, Orders of Medals Society of America Convention, Ft. Lauderdale, Florida, 15 August 1981.

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SYMONDS, Craig L., Associate Professor, "The Politics of Naval Policy in the War of 1812," Southern Historical Association, Louisville, Kentucky, November 1981.

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SYMONDS, Craig L., Associate Professor, "The Projection of U.S. Sea Power in the 1980s," Brigade, U. S. Coast Guard Academy, New London, Connecticut, November 1981.

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PRESENTATIONS

HISTORY DEPARTMENT

THOMPSON, L. V., Professor, "The 'Will' über Alles: Science in the Third Reich," Philosophy Colloquium, U.S. Naval Academy, Annapolis, March 1982.

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WILLIAMS, James W., Lieutenant Commander, USNR, "The Soldier-Citizen: Some Thoughts on Defining the 'Educated Person' in Modern American Society," Annual Conference of the Society for Values in Higher Education, Cornell University, Ithaca, New York, 8-13 August 1981.

\*\*\*\*\*

WILLIAMS, James W., Lieutenant Commander, USNR, "Presenting Ethical Issues Through Historical Studies," Joint Services Conference on Professional Ethics, Fort Benjamin Harrison, Indiana, 7-8 January 1982.



DIVISION OF  
MATHEMATICS AND SCIENCE



## APPLIED SCIENCE DEPARTMENT

Commander William L. Lupton, USN, Chairman



Research in the Applied Science Department plays a vital role in the professional enrichment of both midshipmen and faculty. During Academic Year 1981-1982, research was performed in the Department's three disciplines: Computer Science, Management and Operations Analysis. As a result of the research activities, indicated on the following pages, students gained highly valuable insights into the operational application of their academic disciplines. In addition, a wide variety of naval organizations have benefited directly from this research.

Most of the research by midshipmen was within the Operations Analysis discipline and was supported by an annual grant from the Chief of Naval Operations (OP-953). These funds allowed the faculty members to work closely with operational units and development agencies within the Navy and to provide projects of current interest for midshipmen research.

Faculty research during this year reflect the broad range and applicability of the three disciplines encompassed within the Department. All these efforts are directed toward the ultimate support of the educational experience of midshipmen.

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SPONSORED RESEARCH

APPLIED SCIENCE DEPARTMENT

ELECTRIC AND MAGNETIC FIELDS IN SHALLOW WATER

Researchers: Associate Professor Frank L. K. Chi and  
Assistant Professor Frederick A. Skove

Sponsor: David W. Taylor Naval Ship Research and Development  
Center, Annapolis Laboratory

The interaction between electromagnetic sources and a shallow floor is studied. Models and formulae are developed to predict the electric and magnetic field strengths of electric dipoles, when the bottom conductivity varies. Computer programs are developed and results compared with experimental data.

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AN ANALYSIS OF ACADEMIC GRADES AT THE UNITED STATES NAVAL ACADEMY, 1971-1981

Researchers: Major Malcolm W. Fordham, USA, and  
Associate Professor Randall K. Spoeri

Sponsor: Office of the Academic Dean

In the past decade, an item of concern to educators has been whether or not grades awarded in academic courses have steadily been increasing. This is frequently referred to as "grade creep." This potential problem was an item of concern to the Office of the Academic Dean of the United States Naval Academy. In order to address this concern, a study was conducted in which academic records for the years 1971 through 1981 were analyzed. All grades given during this period were used to check for grade creep, as well as to analyze grade patterns for selected courses, majors, and departments.

Based on the results of the study, it was determined that there has not been any appreciable grade creep during this period. However, several interesting patterns were detected for specific courses and majors.

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A DESCRIPTIVE AND COMPARATIVE STATISTICAL ANALYSIS OF PRIOR NAVAL ACADEMY PREPARATORY SCHOOL STUDENTS VERSUS THEIR PEERS AT USNA, TO ANSWER THE QUESTION: IS NAPS AN EFFECTIVE PREPARATORY SCHOOL?

Researchers: Midshipmen 1/C Ronald D. Fricker, Jr., and Daniel G. Lynch

Adviser: Associate Professor Randall K. Spoeri

Sponsor: Chief of Naval Operations (OP-95)

The Naval Academy Preparatory School (NAPS) in Newport, Rhode Island, provides college preparatory work for enlisted personnel and high school graduates who are academically deficient or who did not obtain a primary nomination to the Naval Academy. The purpose of this study was to use available statistics to analyze the effectiveness of NAPS as a preparation for the United States Naval Academy. Previous studies have been done by Dr. S. Arendt, Academic Dean of NAPS, and Midshipmen G. Basil and J. D. Dauplaise. Arendt's study consists of tabulations of descriptive statistics for the last ten NAPS classes. Basil and Dauplaise's study consists of the application of Analysis of Variance and Linear Regression tests to data from the USNA Class of 1980. Both studies concluded by supporting the existence of NAPS as a preparatory institution.

The purpose of this study was to answer the question, "Is NAPS an effective preparatory institution?" To support this purpose, two objectives were formulated. The first objective was to examine the effectiveness of NAPS in preparing its students academically for study at the U. S. Naval Academy. To study the effectiveness, an analysis of projected plebe year grades was conducted, and an analysis of NAPster's opinions about the institution was completed. The second objective was to compare and contrast NAPster versus non-NAPster performance over the full four-year curriculum to see if NAPS is effective over the long run. Within this objective, an analytic comparison of attrition was completed, and a descriptive comparison of stripers (midshipmen officers) and varsity letter winners was compiled.

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**SPONSORED RESEARCH**

**APPLIED SCIENCE DEPARTMENT**

**AN ANALYSIS OF ACADEMIC GRADES - BY DEPARTMENT**

**Researchers:** Midshipmen 1/C Alison M. Gray and  
Joanne Cerasuolo

**Adviser:** Major Malcolm W. Fordham, USA

**Sponsor:** Office of the Academic Dean

This research effort concentrated on analyzing academic grades issued by academic departments as a whole, from 1971 through 1981. All academic departments were analyzed for all courses, and selected departments were analyzed based on 100, 200 and 300 level, and 400 level courses.

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**MINEFIELD DENSITY ESTIMATION**

**Researchers:** Midshipmen 1/C Darrel M. Morben and  
Arthur R. Salindong

**Adviser:** Associate Professor Randall K. Spoeri

**Sponsor:** Chief of Naval Operations (OP-95)

Minefield reconnaissance provides the data necessary for the estimation of the density of mines in a known or suspected minefield. Mine-density estimates are important in the planning of mine-warfare countermeasures (MCM) and in the prediction of the effectiveness of these countermeasures. Mine-density estimates can be obtained by applying many different statistical methodologies, two of which are the subjects of this report.

The first methodology under consideration was one developed by Michael T. Maliniak, a 1980 United States Naval Academy graduate. Mr. Maliniak's final report was submitted to the operations analysis faculty at the Naval Academy and was made available for use at the Naval Coastal Systems Center in Panama City, Florida. The second methodology under study was one developed for use with line-transect sampling data. Line transect sampling has been used in biological population studies since the early 1930's but has not been evaluated for use in minefield reconnaissance. The statistical methods for the estimation of density from line-transect sampling were summarized in a publication of the Wildlife Society in April of 1980.

The goals of this study were to (1) thoroughly study and evaluate the two methods for use in MCM tactics; (2) compare the methodologies as to their utility in developing minefield density estimates and confidence intervals; and (3) make recommendations and suggestions for further study.

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#### AN ESTIMATE OF THE AREA SURVEYABLE WITH AN AIRBORNE LASER HYDROGRAPHY SYSTEM AT TEN U. S. CITIES

Researchers: Assistant Professor Frederick A. Skove,  
Professor Jerome Williams (Oceanography)

Sponsor: National Oceanic and Atmospheric Administration

The National Oceanic and Atmospheric Administration (NOAA) has been investigating airborne laser-hydrography for several years. The technique uses an aircraft-mounted, scanning beam, pulsed-laser system to measure water depths. Bathymetric soundings resulting from a laser survey are intended for use by NOAA in the production of nautical charts. Separate studies have shown that this technique can gather large quantities of accurate bathymetric soundings at a lower cost and with less manpower than present methods. The improved cost- and manpower-effectiveness for hydrographic surveying are the reasons for NOAA's interest.

Since laser hydrography is an optical technique, its ability to survey an area will be determined principally by the water clarity and water depth to the survey site. There must be a sufficient number of surveyable sites with large contiguous areas of appropriate water clarity and depth in order to realize the desired cost and manpower savings. The purpose of this study was to estimate the laser surveyability of ten sites on the U. S. East Coast, Great Lakes, and Gulf of Mexico for which water clarity and depth data already exist. Such an estimate is useful in assessing the applicability of laser hydrography to NOAA's surveying requirements.

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SPONSORED RESEARCH

APPLIED SCIENCE DEPARTMENT

WATER CLARITY TRENDS IN CHESAPEAKE BAY DURING THE PERIOD 1960-1975

Researchers: Assistant Professor Frederick A. Skove and  
Professor Jerome Williams (Oceanography)

Sponsor: Defense Mapping Agency

A total of 37,000 Secchi Disc Readings taken throughout Chesapeake Bay during the period 1960-1975 were examined for possible indications of any trends. Since the data at any single station were not continuous, area-segment averages were used for each month during the fifteen-year period. Although the trend is generally toward dirtier water over the period studied, the trend was found to be more pronounced in certain areas. The deterioration of this particular water-quality parameter seems to be greater in areas subject to increased urbanization.

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MARINE CORPS AVIATOR RETENTION SURVEY ANALYSIS

Researchers: Midshipmen 1/C Daniel B. Smellow and  
Mara Heatherington

Adviser: Lieutenant Colonel Robert L. Spooner, USMC

Sponsor: Chief of Naval Operations (OP-95)

A survey was conducted by the Center for Naval Analysis for the United States Marine Corps in 1979. The survey responses were from some 4,000 Marine Corps pilots and naval flight officers. This project made an in-depth analysis of aviation retention as it relates to the survey respondents. Recommendations were made, based on the analysis, on ways to improve and aid the retention of aviators in the Marine Corps.

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**NEUROLOGICAL/PSYCHOLOGICAL RESEARCH**

**Researcher:** Associate Professor Karel Montor

A variety of activities were started, continued, and completed during Academic Year 1981-1982 as follows: (1) established a research relationship with the Naval Safety Center to determine if U. S. Naval Academy profile scores may provide advance identification of those pilots most likely to be involved in an accident; (2) established a research relationship with the Navy Personnel Research and Development Center that involves determining whether pre-admission psychological testing might help in U. S. Naval Academy candidate selection procedures; (3) spent the summer doing data analysis of relationships between Class of 1980 brain waves/psychological, motivational profiles vs. academic performance, aptitude, and other factors (175 factors in all); (4) continued neurological research, through individual brain wave analysis and rendering of a second opinion to a neurologist; (5) provided profile/neurological analysis reports to various levels of the U. S. Naval Academy command structure; (6) completed the initial phase of study for the development of a long-range study to reduce myopia among midshipmen.

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**INDENTATION, DOCUMENTATION AND PROGRAMMER COMPREHENSION**

**Researcher:** Associate Professor Anthony F. Norcio

Since memory-organization appears to be a fundamental psychological process, it seems reasonable to assume that indentation and documentation function as aids to comprehension rather than as organizers for memory. The purpose of this study was to examine experimentally the relationship between documentation, indentation, and the comprehension of computer programs.

Using the Cloze procedure, this study examined the effects of documentation and indentation on program comprehension in two separate experiments.

The results suggest that indentation of statements according to the logic hierarchy may aid comprehension. In addition, documentation interspersed between logic segments may enhance comprehension when it is coupled with indentation.

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SUPPLEMENTARY TEXT EDITOR FOR PDP-11

Researcher: Midshipman 2/C Christopher Biow

Adviser: Associate Professor Frank L. K. Chi

This project was to consist of writing a separate text-editor to supplement the RT-11 Editor and TECO systems presently available on the PDP-11 mini-computers at the U. S. Naval Academy. The project was to be open-minded, with the production of a global replace-and-delete function as a minimum achievement. This initial objective has been met, as well as the further objectives of including block-move and file-merge capabilities. The merging of these functions with TECO proved impossible to even attempt, since the requisite source code for TECO was not available.

As presently constructed, the system will perform any of several options. The first option is a global text-replace, in which all occurrences of a string are replaced by a second string. The second string may be a null, in which case the function serves to delete all occurrences of the first string. The second option performs the same function as the first, but prints out each occurrence of the first string and allows the user to choose whether to replace that occurrence: the user may replace it and continue, leave it as it was and continue, end the function, or replace all remaining occurrences. The third function allows the user to delineate a block of text and then copy (insert) the block in as many other locations within the file as desired. He is also given the option to delete the block in its original location. The fourth option allows the user to select another file from the disk. This file can then be inserted anywhere within the original file or appended to the end. Other functions allow the user to see his file as it stands in memory, get a printout of options, abort the edit (leaving the file as it was), or to end the program. Finally, the program automatically produces a backup version of the original, unmodified file to protect against accidental mutilation of the file.

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**PROPOSAL FOR A PERSONAL FINANCIAL MANAGEMENT COURSE AT USNA**

Researcher: Midshipman 1/C Brad M. Weiner

Adviser: Major Ralph C. Rosacker, USMC

This project entailed the basic research necessary to support a formal proposal for a personal financial management course at the U. S. Naval Academy.

The project itself consisted of three basic components. These were: (1) obtaining a suitable text; (2) formulating a meaningful course structure; and (3) preparing the proposal itself. The selection of the text included a thorough acquisition and evaluation process, while the formulation of the course structure encompassed a detailed review of needs and objectives. These two phases of the project continued throughout the semester. The third phase, the proposal, was a formal packaging exercise designed to present the results and positive recommendation of the course as a result of the project.

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PUBLICATIONS

APPLIED SCIENCE DEPARTMENT

MYLANDER, W. Charles, Associate Professor, "The Gas Market Simulator (GAMS): Model Structure," Report, Energy Information Administration, January 1982.

This report is an overview of a model designed to replicate current gas market behavior and to project future behavior under a variety of proposed schemes for phasing out wellhead price controls of natural gas. A key feature of the model is that it stimulates the contracting for production rights of newly discovered reserves by pipeline systems rather than the purchase of natural gas production.

The flow of information between major modules is explained and the structure of common data tables is given. A detailed description of the mathematical structure of the Bidding and Awards module comprises the bulk of the report.

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SPOERI, Randall K., Associate Professor, "A Program of Applied Statistical and Related Quantitative Research at the United States Naval Academy," Proceedings of the 1981 Section on Statistical Education, American Statistical Association, Washington, D.C., (1981), 76-81.

One of the fundamental goals of any educational process is that graduates be able to apply on the job what they have learned in the classroom. At the U. S. Naval Academy, at Annapolis, midshipmen may choose an operations research curriculum offered as an option of either the Applied Science or the Mathematics majors. One important component of this curriculum is thesis-type research projects offered to selected superior students in the final semester of their senior year. Research typically concerns tactical military, Naval Academy, or civilian problems. Most projects ultimately involve the application of statistical and related quantitative methodologies in the solution of the problem.

This paper provides an overview of this program of research. Examples of recent projects are surveyed, along with the impact of the results of these studies on military, Naval Academy, and civilian operations.

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PUBLICATIONS

APPLIED SCIENCE DEPARTMENT

SPOERI, Randall K., Associate Professor, "Statistical Modelling of Historical Shore Erosion Patterns," Chapter VI in An Assessment of Shore Erosion in Northern Chesapeake Bay and the Performance of Erosion Control Structures, Zabawa and Ostrom, editors, Coastal Resources Division, Maryland Department of Natural Resources, (1982).

This study examines the natural erosional features of the northern Chesapeake Bay and relates them to the most effective use of erosion control methods along the shoreline. Forty sites were selected and subjected to detailed study and evaluation. Based on this analysis, recommendations are given regarding preferred methods for erosion control in the Northern Chesapeake Bay. In addition, statistical methods are applied to historical shore-erosion data in an effort to mathematically model the shore-erosion process and identify factors related to coastal retreat.

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PRESENTATIONS

APPLIED SCIENCE DEPARTMENT

SPOERI, Randall K., Associate Professor, Ted R. Maynard, Lieutenant Commander, USN, James D. Hefferman, Ensign, USN, and Gregory L. Point, Ensign, USN, "An Approach to Solving a Spare Parts Problem Under an Operational Availability Scenario," 47th Symposium of the Military Operations Research Society, Ft. McNair, Washington, D. C., 8 July 1981.

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SPOERI, Randall K., Associate Professor, "A Program of Applied Statistical and Related Quantitative Research at the United States Naval Academy," 141st Annual Meeting of the American Statistical Association, Detroit, Michigan, 10 August 1981.

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## CHEMISTRY DEPARTMENT

*Commander William H. Rivera, USNR, Chairman*



This year's research report mirrors the changes that have occurred in the Department in the recent past. Many of the old names are now absent because of retirements, but new names have taken their places. The shift has also seen less applied research and more basic research, but the cooperative ties with the Naval Research Laboratory and the David Taylor Naval Ship Research and Development Center continue to be strong and active. Sponsorship has expanded to sources outside of the Navy community, with Research Corporation grants appearing for the first time.

Both the publication and the presentation lists record the vigorous activities of our new faculty members. Beside studies as diverse as ant-venoms and electrolysis of fused salts, there is a consistent theme of service to educational improvement as seen in public presentations and publication in the Journal of Chemical Education.

The Department feels that participation in research by the midshipmen is an important part of the education of a chemist. The Department had two Trident scholars and six other midshipmen involved in research courses this year. Three other students participated in research for no academic credit.

**HYDROGEN ELIMINATION FROM METAL DIMERS**

**Researcher:** Lieutenant Commander Thomas E. Bitterwolf, USNR

**Sponsor:** Naval Academy Research Council and Research Corporation

Ferrocene dimers, in which two ferrocenes are held in a rigid relative orientation so that the metal atoms are comparatively close to each other, have been observed to evolve hydrogen in very strong acids. Because of the considerable interest in this reaction as a possible method for doing water-splitting in a solar hydrogen scheme, the researcher prepared other metal dimer systems which are likely to evolve hydrogen under less stringent acid conditions.

A series of three new chromium compounds have been prepared, and all have been shown to liberate hydrogen upon addition of strong acid. The reaction mechanism of these reactions has been studied. Cyclic voltammetry has been studied in collaboration with Professor Cheek of USNA, and a collaborative effort to determine the molecular structure of these compounds is underway with Professor Arnold Rhinegold of the University of Delaware.

Efforts are now underway to prepare related compounds of several metals including cobalt, iron, manganese, molybdenum, and tungsten.

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**TIGHT-BINDING MODEL FOR THE ELECTRONIC STRUCTURE OF POLYACETYLENE**

**Researcher:** Assistant Professor Mark L. Elert

**Sponsor:** Naval Research Laboratory

Polyacetylene is a semiconducting linear polymer whose conductivity can be enhanced enormously by appropriate doping. Studies of the electronic structure of polyacetylene are important for understanding its unique electrical properties, but traditional single-molecule methods are cumbersome when applied to the infinite chain polymer, and cannot be easily extended to include the effects of disorder and doping.

A tight-binding model was developed in which the electronic structure of polyacetylene is expressed entirely in terms of nearest-neighbor interactions. Interaction energies were obtained by parameterizing on the well-studied graphite system, and a  $1/d^2$  scaling law was used to extend the results to polyacetylene. A theoretical XPS spectrum calculated from this model is in excellent agreement with experiment.

SPONSORED RESEARCH

CHEMISTRY DEPARTMENT

Because of the simplicity of the tight-binding model, it can be easily extended to incorporate various realistic defects. As one example, a probabilistic method has been developed to study the effects of bond-length disorder on the important mid-gap soliton states of polyacetylene. The localized soliton states are seen to exhibit surprising stability in the presence of appreciable disorder. The effect of certain chain intersections and ring-like structures on the electronic structure of polyacetylene have also been investigated.

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**SEDIMENT CHARACTERIZATION IN SYNTHETIC FUELS AND NITROGEN DETERMINATION OF SYNTHETIC FUELS**

**Researcher:** Associate Professor Frank J. Gomba

**Sponsor:** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The sediment in synthetic fuels was examined as to its possible composition. The fuel samples were stored in steel drums, and the sediment was found to contain about 30% iron with hydrocarbons which have appeared to resist melting (at 200°C). The nitrogen content appears to be negligible although many nitrogen compounds have been shown to be "bad actors" in causing synthetic fuels to be unusable as a Navy fuel. Determination of N content by converting all N to NO has been met with some success, but the method appears not to work with all N containing compounds. Work on N and S content is continuing.

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**SYNTHESIS OF 2-AZA-4-THIOBICYCLO(4,3,0)NONATRETRAENE**

**Researcher:** Captain Ralph Haddock, USMC

**Sponsor:** Naval Academy Research Council

Preparation of the title compound and study of its aromatic character are the goals of the study. Several intermediates, needed for the preparation, have been prepared.

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**AN ANALYTICAL EXAMINATION OF ORGANOTIN ESTERS USED IN THE FORMULATION OF OMP EPOXY RESINS**

**Researcher:** Professor Samuel P. Massie, Jr.

**Sponsor:** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

Infrared spectral examination was made of four samples of polymeric ester resins, prepared from tributyl tin oxide (TBTO) and a styrene-maleic anhydride polymer, formulation SMA 1000, containing an approximately 60% ester formulation. The techniques studied involved either one percent (by weight) KBr pellets or 10% solute in carbon tetrachloride solutions between matched KBr plates of 0.1 mm path length. These examinations showed that all four samples were identical and showed characteristic identifying peaks, even though the samples were prepared by different manufacturers, and exhibited different physical properties. The solution technique was determined to be better, and it thus appears that IR spectral examination of 10 percent carbon tetrachloride solutions can be used as a base for quality control analysis of these esters, important intermediates in the preparation of antifouling paints.

Esters, resembling the monomers of these polymeric esters, were made in quantitative yields from tributyl tin oxide and dibasic acids (succinic, malonic and adipic) and also from succinic anhydride. These esters were identical to those reported in other studies.

A preliminary study of the use of hydroxamic acids, derived from tributyl tin esters, as a method of the use of hydroxamic acid color complexes for accurately analyzing the ratio of ester/anhydride was begun, but further studies are needed.

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**ORGANOMETALLIC COATINGS PROGRAM**

**Researcher:** Associate Professor John W. Schultz

**Sponsor:** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The characterization of organometallic tin polymers by traditional methods has failed to distinguish between batches of polymers which perform well and those which perform poorly as antifouling coatings. Thus the purpose of this research is to find alternate methods of characterizing organometallic tin polymers. A Varian FT 80A Fourier-Transform NMR Spectrometer was used to observe the tin signal in the polymer. Unfortunately, the tin signal is broad, resulting in poor signal-to-noise ratios, even with acquisition times of many hours. The addition of a tin standard to a sample so that chemical shifts could be measured would make the problem worse. While tin NMR might be feasible on a larger instrument, it appears that the FT80A is unsuitable for this purpose. Preliminary work on the Raman spectra of tin polymers is much more promising. At the very minimum, Raman spectra can distinguish quantitatively between samples made with different ratios of the two monomers used as starting materials. This has not been possible before.

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**SYNTHESIS OF AZULOQUINONES**

**Researcher:** Midshipman 1/C Joseph Donovan

**Adviser:** Professor Charles F. Rowell

**Sponsor:** Trident Scholar Program

An eleven step synthetic route to synthesize the 1,5-, the 1,6- and the 1,7-azuloquinones was undertaken. The route proved feasible but final characterization of the product molecules was not completed.

These molecules hold interest as experimental tests of recent theoretical calculations and as members of a family of compounds of wide biological application.

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## SYNTHESIS OF POTENTIALLY CATALYTIC DOUBLE METAL COMPOUNDS

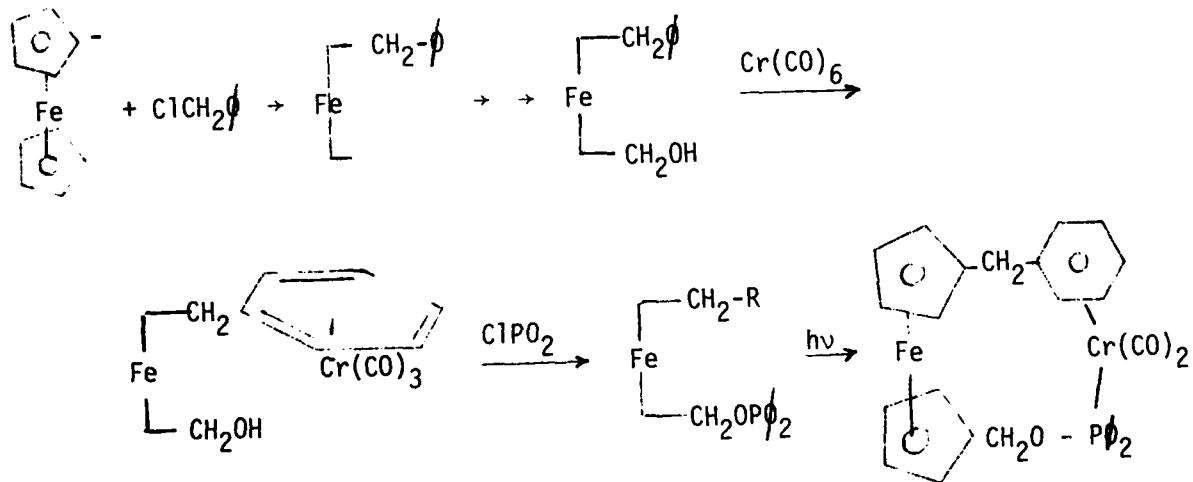
Researcher: Midshipman 1/C Michael Golightly

Adviser: Lieutenant Commander Thomas E. Bitterwolf, USNR

Sponsor: Trident Schclar Program

Compounds in which two metal atoms are in fixed, adjacent positions are attractive as catalysts for hydrogen evolution and the fixation of small molecules such as carbon dioxide and nitrogen. Although the bulk of the current research has been with symmetric compounds, there is reason to believe that assymmetric compounds with different metal centers might have unique properties. Of particular interest is the possibility that visible light might be able to transfer electrons from one metal center to another in an internal redox reaction.

The compounds which have been prepared in this project have used ferrocene as a backbone to which a second metal center is attached. The reaction scheme shown below has been followed to within one step of completing this scheme.



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RESEARCH COURSE PROJECTS

CHEMISTRY DEPARTMENT

HETEROCYCLIC THIOSEMICARBAZONES AS POTENTIAL ANTIMALARIAL AND ANTIBACTERIAL AGENTS

Researchers: Midshipmen 1/C Sheila A. Duffy and Richard R. Johnson

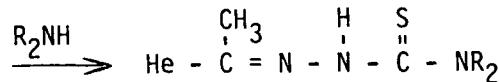
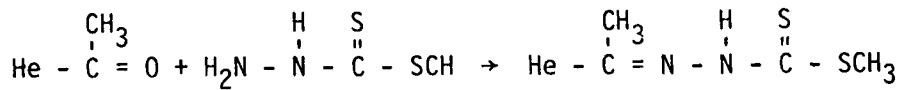
Adviser: Professor Samuel P. Massie, Jr.



Compounds of the general structure He - C = N - N - C - NR<sub>2</sub> where He = pyridine (Walter Reed Army Institute of Research) and quinoline (U. S. Naval Academy - with Grant and Gonzalez) have shown interesting properties against gonococci. (A patent is being applied for, based on the work with Grant and Gonzalez). The compounds with pyridine showed interesting activity against Herpes II. It was, therefore, of interest to study other heterocyclic or aromatic nuclei.

The heterocyclic nucleus, pyrrole, was briefly studied. Two compounds were prepared using the aromatic nucleus and five compounds using the heterocyclic nucleus. These all analyzed correctly and have been submitted to WRAIR for testing. No test results have been received.

The general method of synthesis was:



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THE EFFECTS OF CO<sub>2</sub> CONCENTRATION AND LIGHT INTENSITY ON THE GROWTH OF PHALAENOPSIS SEEDLINGS

Researcher: Midshipman 1/C Bradford Martin

Adviser: Assistant Professor D. Lawrence Weingartner

The purpose of the study was to investigate the effects of two environmental variables, light intensity and CO<sub>2</sub> concentration, on the growth of orchid seedlings. In the experimental design, the seedlings were partitioned into four groups of 25 plants each. They were placed under fluorescent lights (16 hours on, 8 hours off) with two groups exposed to 175 foot-candles and the other two to 260 foot-candles. Of the two groups under each light regime, one group was exposed to normal atmospheric CO<sub>2</sub> concentrations, while the other was subjected to elevated CO<sub>2</sub> levels produced by a yeast generator. Actual levels of CO<sub>2</sub> were monitored daily. It was planned to measure growth by weighing the plants at intervals during the study; the three-month duration of the investigation however, was insufficient to allow the plants to recover from transplant shock and the resultant partial tissue death. Nevertheless, visual inspection suggests that growth of new roots is stimulated by elevated CO<sub>2</sub>.

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PREPARATION, COMBUSTION, AND ANALYSIS OF COAL-ALCOHOL MIXTURES

Researchers: Midshipmen 1/C Douglas Nordman and Peter Schulert

Adviser: Assistant Professor Edward D. Walton

This report examines coal-alcohol mixtures (CAM) and evaluates the feasibility of testing their combustion characteristics on a small scale. While industrial testing of alternate fuels is usually done in large plants for extended periods, requiring a considerable investment in money and time, this study worked with test burnings of four-liter samples, computer simulations, and calorimetry.

The samples contained 10-20% mixtures of approximately 75-micron coal particles in ethanol or methanol, some with a 5% water content. These suspensions settle quickly, but can easily be re-mixed.

Several CAM firings were performed in a Continuous Combustion Unit (CCU). The samples generally burn with characteristics similar to diesel or propane. Fuel-line fouling is a hazard; those samples with 5% water burn more completely and with little clogging.

A computer program obtained from NASA, CEC71, was used to simulate CAM combustions. Computer generated data was compared with data obtained from the CCU in order to see if predictions for optimum fuel-to-air ratios and CAM compositions could be determined.

The program's predicted values of fuel-to-air ratios for peak burn temperatures were very close to values obtained from the CCU. The burn temperature data from the computer did not match the temperatures or temperature trends obtained from the CCU.

A calorimetry technique was successfully worked out.

Small-scale testing of samples in a small burner, aided by calorimetry and computer simulations, appears to be a valid approach to the study of CAMs.

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#### SUBSTITUENT CONSTANTS OF ORGANOMETALLIC SPECIES BY F-19 NMR

Researchers: Midshipmen 1/C Douglas Otte and Steven Jones

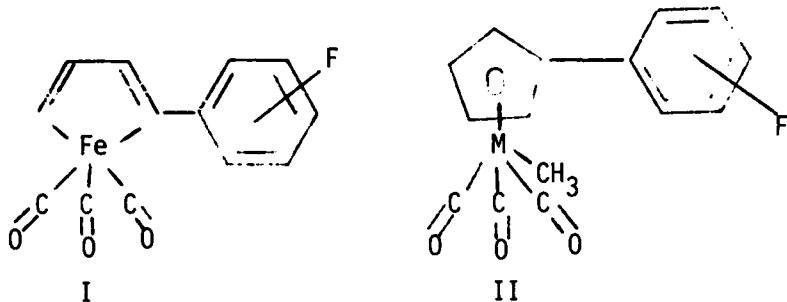
Adviser: Lieutenant Commander Thomas E. Bitterwolf, USNR

The electronic changes which take place when an organic group is complexed to a transition metal are qualitatively well understood. In several cases the chemical properties of a bound organic group are drastically changed so that reactions become possible which are forbidden on the free compound. Along the same lines, variation of the ligands on the metal center can influence the electronic properties of an attached organic species. Changes such as these have been extensively examined for substituents in conventional organic chemistry through measurement of properties such as acidity, basicity or rates of solvolysis, but the solvent conditions required for these measurements are often deleterious to organometallic compounds.

An alternate technique for measuring substituent effects uses the changes in F-19 chemical shift caused by the presence of a substituent on a benzene ring. This technique is applicable to a wide range of compounds since the only requirement is that the compounds be soluble in any one of several common solvents. Air sensitive compounds can easily be dealt with.

In order to examine the application of the F-19 technique to organometallic compounds, the preparation of compounds of the type shown below has been undertaken.

Compounds of type II where M is Mo and W were prepared.



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#### ELECTROCHEMICAL STUDIES OF THE LITHIUM-THIONYL CHLORIDE CELL

Researcher: Midshipman 1/C Arthur J. Platt

Adviser: Assistant Professor Graham T. Cheek

The purpose of this research was to investigate thionyl chloride reduction in lithium-thionyl chloride cells by electrochemical methods. Preparation of the glovebox intended for this work involved both sealing the box to prevent leaks in the system and installation of a circulating purification system to remove traces of oxygen and moisture in the argon atmosphere. Electrochemical investigations were carried out on the cells using thin (1-2 mm) slices of lithium as anodes, spectroscopic carbon rods as cathodes, and Pyrex wool as separator material. Open circuit voltages of the cells agreed fairly well with literature values (approximately 3.7V); however, high internal cell resistance caused voltages to fall markedly upon discharge. Voltammetric studies using glassy carbon as working electrode produced current-potential curves (cyclic voltammograms) similar to those found in published results for thionyl chloride reduction. Further work employing normal pulse voltammetry showed that intermittent potential application is not sufficient to appreciably reduce the effects of passivation of the working electrode by lithium chloride film formation upon thionyl chloride reduction.

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A FEASIBILITY STUDY OF COAL-ALCOHOL MIXTURES AS SYNTHETIC FUELS  
BY PETROLEUM TESTING METHODS

Researcher: Midshipman 1/C Charles Toner

Adviser: Assistant Professor Edward Walton

The alternate use of coal-alcohol slurries in a commercial synthetic fuel has been suggested based on its widespread availability. This report is concerned with measurement of the feasibility of such coal-alcohol mixtures (CAM) as fuel sources through standard laboratory fuel testing methods. The tests performed are well-documented standardized methods which are published by the American Society for Testing and Methods (ASTM). The following tests were successfully performed on the 20% CAM samples: Kinematic Viscosity, API Gravity, Pour Point, Bottom Sediment, Acid Number, Color, and Flash Point.

A determination of the CAM's feasibility as viable fuel sources was projected based on the results obtained by the lab tests. The Navy standards for marine diesel fuel were used as a point of comparison as to the value of tests and interpretation of results. The CAM as a fuel source was determined to have several inherent shortcomings, based on its poor stability (the rapid settling) difficulty in handling and storage, low flash point, and probable inefficient cost of production.

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ELERT, Mark L., Assistant Professor, co-author, "Effects of Disorder on Trans-Polyacetylene," Polymer Preprints, 23 (1982), 111.

Geometric disorder is expected to affect the electronic states associated with Pople-Walmsley (soliton-like) defects in polyacetylene. To study the effects of this disorder, a model has been developed which assumes a nearest-neighbor tight binding description of the pi band and divides the hopping matrix elements into two sets corresponding to double and single bonds. Each matrix element is then taken as a random variable obeying a rectangular probability density of adjustable width, centered around the ideal dimerized value. Pople-Walmsley defects are introduced into the model by assuming that the probability of having a single-bond-like matrix element ( $V_1$ ) on a site given that the previous site is of  $V_1$  type is  $X$ , while the probability of having a  $V_1$ -type matrix element given that the previous site is of double-bond ( $V_2$ ) type is unity.

The density of states resulting from this model can be obtained by solution of an exact set of functional-integral equations. For realistic values of the parameters, it is found that the midgap band arising from the soliton-like defects maintains its integrity well in the presence of disorder sufficient to appreciably smear the edges of the pi band as seems to be required by experiment.

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ELERT, Mark L., Assistant Professor, co-author, "On the Overtone Combination Spectra of  $XY_2$  Molecules," Journal of Chemical Physics, 74 (1981), 6050.

Overtone and combination features in the infrared spectra of  $XXY$  molecules arise from several different effects: (1) anharmonicity in the individual stretch and bend motions; (2) coupling of stretches and bend via nonseparable terms in the potential energy; and (3) nonlinear dependence of the dipole moment on the stretch and bend displacements. In order to unambiguously sort out these contributions, it is necessary to know the coordinate dependence of both the dipole moment and the potential energy, from which follow the line positions and the oscillator strengths.

In this paper the general criteria for separability of the nuclear potential energy with respect to stretch and bend motions are discussed. Preference for "local" versus "normal" coordinates is shown to derive from the atomic mass differences and bonding types. The infrared spectrum of the HOH molecule is treated in detail, since a great deal of information is already available

concerning its potential energy surface and the coordinate dependence of its dipole moment. First the vibrational eigenstates are obtained and used to study the breakdown of separability with increasing energy. Then the relative intensities of neighboring overtone and combination states are compared, and accounted for in terms of "electrical" (dipole moment) and "vibrational" (potential energy) anharmonicity.

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ELERT, Mark L., Assistant Professor, co-author, "Tight-Binding Studies on Polyacetylene," Polymer Preprints, 23 (1982) 114.

The electronic Hamiltonian for polyacetylene was parameterized within the tight-binding formalism by using carbon-carbon interaction energies obtained from the graphite system, together with a  $1/d^2$  scaling law. The C-H parameters were obtained by requiring overlap between the highest occupied  $\sigma$  band and the valence  $\pi$  band, as had been observed experimentally. The resulting Hamiltonian was used to generate the density of states directly in the site representation, using an effective-field Green's function approach. A theoretical XPS spectrum was calculated by this method, with retention of an imaginary energy component leading directly to an appropriate Lorentzian broadening. Comparison with experiment shows agreement superior to that obtained from more elaborate ab initio calculations.

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GOMBA, Frank J., Associate Professor, co-author, "High Strength Steel Weldment Subcritical Cracking Program Seawater Stress-Corrosion Cracking Resistance of High-Strength Steel Weldments," DTNSRDC/SME - 80/89, July 1981.

A program has been initiated to develop metallurgical and fabrication technology guidelines for providing steel weldments in the 100 to 200 thousand pounds per square inch (690 to 1350 megapascals) yield strength range which will be resistant to subcritical cracking. This report describes the stress-corrosion testing conducted in flowing natural seawater at  $-1000 \pm 5$  millivolts versus a silver-silver chloride reference cell. It was found that the stress-corrosion cracking threshold for HY-130 base plate was superior to those determined for HY-180 plate, both the 10 Ni and 9 Ni alloys at various yield strengths. Fine-grained gas tungsten-arc welds using HY-130 type consumable electrodes produced welds with thresholds nearly equal to the HY-130 base plate. Both gas metal-arc and shielded metal-arc welding processes produced welds with inferior stress-corrosion cracking thresholds.

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JONES, Tappey H., Assistant Professor, co-author, "A Facile Synthesis of 2-hydroxy-6-methylacetophenone," Synthetic Communications, 11 (1981), 889-894.

A short synthesis of the title compound with good yields and high purity is reported. The compound has been found to occur in several ant species and is of marked interest as a result.

\*\*\*\*\*

JONES, Tappey H., Assistant Professor, co-author, "Anthraquinones and Anthrones: Occurrence and Defensive Function in a Chrysomelid Beetle," Naturwissenschaften, 69 (1982), 91.

The title compounds were isolated from beetles larvae in the attempt to understand the ant repellent character of these larvae. Various substituted members of the general family were found to be present and active.

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JONES, Tappey H., Assistant Professor, co-author, "Biochemistry of Termite Defenses: Coptotermes, Rhinotermes and Cormitermes Species," Comparative Biochemistry and Physiology, 71B (1982) 731-733.

The frontal gland secretion of soldiers of Coptotermes testaceus is dominated by hexadecanal and heptadecanal. Nonodecanoic acid is the major constituent present in the secretion of Rhinotermes marginalis. Soldiers of Cornitermes weberi produce phenylacetaldehyde, 2-piperidone and N-methyl-2-piperidone in their frontal glands, whereas those of C. ovatus and C. pugnax synthesize the lactone mellein. Both mellein and phenylacetaldehyde are deterrent to ants at low concentrations. The significance of these findings in terms of the comparative biochemistry of termite defenses is discussed.

\*\*\*\*\*

JONES, Tappey H., Assistant Professor, co-author, "Defensive Secretions of Tiger Beetles: Cyanogenetic Basis," Comparative Biochemistry and Physiology, 69B(1981), 903-904.

The defensive secretion of the tiger beetle Megacephala virginica contains benzaldehyde, HCN, and mandelonitrile. The significance of convergent biochemical evolution in the Arthropoda for the production of benzaldehyde and HCN by cyanogenesis is discussed.

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PUBLICATIONS

CHEMISTRY DEPARTMENT

JONES, Tappey H., Assistant Professor, co-author, "Structure and Synthesis of Gastrolactone," Tetrahedron Letters, 22(1981), 4374-4376.

The novel cyclopentenoid monoterpenone, gastrolactone (4), was synthesized from carvenolide (5), and the synthetic material was found to be identical to the natural product by direct comparison. This synthesis confirmed structure 4 which had been suggested earlier on the basis of spectral data.

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JONES, Tappey H., Assistant Professor, co-author, "Venom Chemistry of Ants in the Genus Monomorium," Journal of Chemical Ecology, 8(1982), 285-298.

A comparative analysis of the venomous alkaloids produced by ant species in the subgenus Monomorium of the genus Monomorium has been undertaken. All species produce mixtures of unsymmetrical trans-2,5-dialkylpyrrolidines, but the proportions of the constituents may vary considerably between species. All alkaloids contain both C<sub>6</sub> and C<sub>9</sub> side chains which are present as C<sub>9</sub>-saturated, C<sub>6</sub>-monounsaturated, and both C<sub>6</sub>- and C<sub>9</sub>-monounsaturated dialkyl-pyrrolidines. The structure of 2-(1-hex-5-enyl)-5-(1-non-8-enyl-pyrrolidine), a previously undescribed alkaloid, was proved by unambiguous synthesis after the location of the double bonds was established by the methoxymercuration-demercuration followed by mass spectrometry. The possible chemotaxonomic significance of the mixtures of venomous alkaloids produced by these species of Monomorium is discussed.

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KOUBEK, Edward, Professor, and Mark ELERT, Assistant Professor, "Component Vapor Pressures as a Function of Initial Quantity of a Solution," Journal of Chemical Education, 59(1982), 357-359.

The significance of equilibrium as a required condition for the application of Raoult's Law is emphasized by examining the vapor pressures that arise when a significant portion of the initial solution evaporates to establish the vapor phase.

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PUBLICATIONS

CHEMISTRY DEPARTMENT

WALTON, Edward, Assistant Professor, "Science Education for Developing Nations," the IInS Program, National Organization of Black Chemists and Chemical Engineers Newsletter, 3(1982), 8.

This paper addressed the need for increased attention to and work towards a better science education program. It describes the interests and involvement in science programs as a prototype program that can be useful.

\*\*\*\*\*

WEINGARTNER, D. Lawrence, Assistant Professor, "A Field-tested Internal Tag for Crayfish," Crustaceana, 12(1982), 18.

A brief review of tagging methods is followed by a description of a new type of tag for crayfish. This injected, color-coded, nylon rod features permanence through several molts, recognition of individuals, and identification without sacrificing the marked animals. Field testing of this tagging method indicated that no interference with the behavior, growth or longevity of the crayfish occurred. The principal drawback of this tagging system is the time involved in preparing and applying the tag.

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PRESENTATIONS

CHEMISTRY DEPARTMENT

BITTERWOLF, Thomas E., Lieutenant Commander, "Preparation and Protonation of Arene Chromium Dimers," Middle Atlantic Regional Meeting of the American Chemical Society, Newark, Delaware, April 1982.

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BITTERWOLF, Thomas E., Lieutenant Commander, "Metal Dimer Hydrides and Carbon Dioxide Fixation," Office of Naval Research Symposium on Carbon Dioxide Chemistry, NRL, Washington, D.C., April 1982.

\*\*\*\*\*

BITTERWOLF, Thomas E., Lieutenant Commander, "Oxidative Elimination of Dihydrogen by Basic Bimetallic Compounds in Strong Acids," Inorganic Chemistry Towards the 21st Century, Division of Inorganic Chemistry of the American Chemical Society, Bloomington, Indiana, May 1982.

\*\*\*\*\*

CHEEK, Graham T., Assistant Professor, "Electrochemical Studies of Benzoyl Chloride," Gordon Conference on Electrochemistry, Ventura, California, 1982.

\*\*\*\*\*

CHEEK, Graham T., Assistant Professor, "Electrochemical Studies of Benzoyl Halides," 16th Middle Atlantic Regional Meeting, ACS Newark, Delaware, 22 April 1982.

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CHEEK, Graham T., Assistant Professor, "Electrochemical Studies in Molten Salts," Seminar at Naval Surface Weapons Center, Silver Spring, Maryland, June 1981.

\*\*\*\*\*

CHEEK, Graham T., Assistant Professor, "Study of Novel Electrode Systems:  $(SN)_x$ ,  $(SNBr_{0.3})$ , and Modified-Pt Electrodes," Branch Review at Naval Research Laboratory, Washington, D. C., June 1981.

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PRESENTATIONS

CHEMISTRY DEPARTMENT

CHEEK, Graham T., Assistant Professor, co-author, "Electrochemistry of Conducting Polymers and Their Doped Variants," 16th Middle Atlantic Regional Meeting, American Chemical Society, Newark, Delaware, 22 April 1982.

\*\*\*\*\*

CHEEK, Graham T., Assistant Professor, co-author, "Conducting Polymer Electrochemistry:  $(SN)_x$ ,  $(CH)_x$ , and Their Doped Variants," Electrochemical Society Montreal Meeting, May 1982.

\*\*\*\*\*

ELERT, Mark L., Assistant Professor, "A Tight Binding Model for the Electronic Structure of Polyacetylene," Department of Chemistry, Ohio State University, Columbus, 29 January 1982.

\*\*\*\*\*

ELERT, Mark L., Assistant Professor, "Effects of Disorder on Pople-Walmsley Defects in Trans- $(CH)_x$ ," 1982 March Meeting of the American Physical Society, Dallas, Texas, 11 March 1982.

\*\*\*\*\*

ELERT, Mark L., Assistant Professor, "Effects of Disorder on Trans-Polyacetylene," 183rd National Meeting of the American Chemical Society, Las Vegas, Nevada, 31 March 1982.

\*\*\*\*\*

ELERT, Mark L., Assistant Professor, "Tight-Binding Studies on Polyacetylene," 183rd National Meeting of the American Chemical Society, Las Vegas, Nevada, 31 March 1982.

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JONES, Tappey H., Assistant Professor, "Ant Venoms and Ant Repellents," Howard University, Washington, D. C., 23 April 1982.

\*\*\*\*\*

JONES, Tappey H., Assistant Professor, "Gastrolactone, A Novel Iridoid Monoterpene Lactone," 33rd Southeastern Regional Meeting of the American Chemical Society, Lexington, Kentucky, 5 November 1981.

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PRESENTATIONS

CHEMISTRY DEPARTMENT

SHEETS, Donald G., Professor, co-author, "Determination of High Pressure Autogeneous Ignition Temperature of a Steam Turbine Lubricating Oil in Atmospheres of Nitrogen and Oxygen Mixtures," Symposium on Flammability and Sensitivity of Materials in Oxygen-enriched Atmospheres, ASTM, Phoenix, Arizona, 31 March - 1 April, 1982.

\*\*\*\*\*

WALTON, Edward, Assistant Professor, "Status of Science: Needs and Programs," Frontiermen International, Annapolis, Maryland, 27 February 1982.

\*\*\*\*\*

WALTON, Edward, Assistant Professor, "Vibration Frequencies and Correlations in Phosphine Chalcogen Compounds," Howard University, Washington, D.C., Summer 1981.

\*\*\*\*\*

WALTON, Edward, Assistant Professor, "Books and Apparatus for Chemical Education," 6th International Conference on Chemical Education, College Park, August 1981.

\*\*\*\*\*

WALTON, Edward, Assistant Professor, "Catalyst in Chemistry," Hampton Institute, Hampton, Virginia, December 1981.

\*\*\*\*\*

WALTON, Edward, Assistant Professor, "Black Scientist and Research," David Taylor Naval Ship Research and Development Center, Annapolis, March 1982.

\*\*\*\*\*

WALTON, Edward, Assistant Professor, "The Nature of Chemistry," Ninth Annual National Meeting of the National Organization of Black Chemist and Chemical Engineers, May 1982.

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PRESENTATIONS

CHEMISTRY DEPARTMENT

WALTON, Edward, Assistant Professor, "Keynote Graduation Address,"  
Upward Bound Project, New Jersey Institute of Technology,  
Newark, New Jersey, 11 June 1982.

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WATRAS, Ronald E., Major, USAF, "Commercial Books and Apparatus,"  
Sixth International Conference on Chemical Education, University  
of Maryland, College Park, Maryland, 9-14 August 1981.

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## MATHEMATICS DEPARTMENT

*Professor Theodore J. Benac, Chairman*



Research is an integral part of the professional activities of the members of the Mathematics Department. Present investigations include studies in group theory, algebraic geometry, topology, differential equations, number theory, graph theory and statistics. In a growing number of cases the research supports on-going science/engineering projects and is concerned with problems such as computer modeling for solid-state investigations, the phenomena of acoustic scattering and heat flow, and the statistical analysis of data.

The research activity of the staff has produced a number of scholarly articles and presentations. Sources of funding have included the Naval Academy Research Council, the David Taylor Naval Ship Research and Development Center and the Anti-Submarine Warfare Systems Projects Office, Naval Sea Systems Command.

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**ANALYTIC PROPAGATION LOSS COMPENSATION TERM**

Researcher: Associate Professor Peter P. Andre

Sponsor: Naval Sea Systems Command (Anti-Submarine Warfare Systems Project Office)

The figure-of-merit has been used to decide which of two frequencies should be used to search for a target. This measure is adequate only if the propagation loss curves of the two frequencies are essentially the same. If the propagation loss curves of the two frequencies are different, a term must be added to the figure of merit to adjust for the difference in the propagation loss curves. This term has been computed, in the past, by Monte Carlo methods. However, such methods are costly and have a degree of uncertainty. Therefore, a program to compute propagation loss compensation term by analytical means is useful.

The program performs a weighted average. The weights make use of Target Speed, Sensor Placement, and Figure of Merit. The averaging is done in a one-dimensional scheme driven by the propagation loss. The method appears accurate, but it still remains costly in terms of computer time.

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**FUNDAMENTAL ORBITS**

Researcher: Assistant Professor Craig K. Bailey

Sponsor: Naval Academy Research Council

The orbit-size of a point in a tree (a connected graph with no cycles) is the cardinality of the orbit of the automorphism group of the tree in which the point lies. The fundamental orbit-size of a point is a similar concept but so defined that the cardinality of the automorphism group of the tree is the product of the fundamental orbit-sizes of the points. This is important because the size of the automorphism group relates to the probability with which the organic molecule that the tree-models arises in nature.

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**INHOMOGENEOUS CAUCHY-RIEMANN EQUATIONS**

Researcher: Assistant Professor James L. Buchanan

Sponsor: Naval Academy Research Council

It has long been known that solutions to the differential equation  $D^*w + Aw + Bw^* = 0$ , where  $w$ ,  $A$ , and  $B$  are complex valued functions and  $D^*$  is the Cauchy-Riemann operator, satisfy the similarity principle:  $w = f \exp(s)$ , where  $f$  is analytic and  $s$  is bounded. The similarity principle establishes the function theoretic properties of solutions to the differential equation, e.g., zeros must be isolated and of finite order and entire solutions obey Liouville's theorem.

The investigator has proved the similarity principle for the case where  $A$  and  $B$  are complex valued matrix functions with compact support. Here the similarity principle takes the form  $w = Sf$ , where  $f$  is an analytic vector and  $S$  is nonsingular with the degrees at infinity of the column vectors summing to zero. The investigator is presently attempting to extend the methods employed in demonstrating this result to more general elliptic systems. It is hoped that the similarity principle will be useful in extending certain approaches to solving boundary value problems for elliptic systems.

The investigator also plans to explore generalizations of results on elliptic systems in the plane to systems in several complex variables.

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**ACOUSTIC HIGH-FREQUENCY SCATTERING BY ELASTIC CYLINDRICAL SHELLS**

Researcher: Associate Professor James M. D'Archangelo

Sponsor: David Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The Sommerfield-Watson transformation for evaluating slowly-converging series via contour integrals has previously been applied to the problem of acoustic scattering from an elastic cylinder in a fluid, resulting in a description of the scattering process in terms of surface and transmitted waves. In this approach, the normal mode series for the scattering amplitude is rewritten as a sum of two contour integrals. The first integrand is evaluated by expanding in a series whose terms can be integrated by the saddle point method; the second can be evaluated in terms of residues of the poles of the integrand which, due to certain parameters, had to be expanded via asymptotic series.

In the present project the above method is applied in the case of an aluminum cylindrical shell to evaluate the amplitudes of all contributions to the scattered acoustic field in order to assess their relative importance in the scattering process.

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NONPARAMETRIC TESTS OF DEPENDENCE

Researcher: Assistant Professor Gary O. Fowler

Sponsor: Naval Academy Research Council

Recently it has been established that the copula of two random variables captures the properties of their joint distribution that are of interest in much of the study of rank statistics. Specifically, the  $L_p$  norm on the set of copulas results in a measure of dependence that is zero exactly when the random variables are independent and is invariant under strictly monotone transformations of the random variables. Some commonly used measures of correlation, such as Kendall's tau, do not satisfy these properties. Thus, they are not measures of dependence. The measure resulting from the copula has the additional property that it is easily extended to include the investigation of more than two random variables. The problem being investigated is the construction of an estimator, test statistic and rejection region that will result in a test for dependence based on this measure. The distribution of the test statistic for small sample sizes and the limiting distribution are to be computed. Questions of bias, consistency, and power are also to be investigated.

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NILPOTENT PRODUCTS OF CYCLIC GROUPS

Researcher: Assistant Professor Anthony M. Gaglione

Sponsor: Naval Academy Research Council

Let  $G$  be a free product of a finite number of cyclic groups at least one of which is of finite order. Let  $G_n$  denote the  $n$ -th subgroup of the lower central series of  $G$ . The main objective of this investigation is to study the possibility of completely determining all the nilpotent products  $\bar{G}_n = G_n/G_{n+1}$  for  $n = 1, 2, 3, \dots$  where the term 'completely determine' means to find presentations in terms of generators and defining relators for the groups  $\bar{G}_n$ .

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SPONSORED RESEARCH

MATHEMATICS DEPARTMENT

COVERING PROPERTIES OF TOPOLOGICAL SPACES WITH SET THEORETIC ASSUMPTIONS

Researcher: Assistant Professor Marlene E. Gewand

Sponsor: Naval Academy Research Council

The objective of this project is to expand and generalize the results of a previous Naval Academy Research Council project, "A Study of Covering Properties of Scattered Topological Spaces."

Several results concerning the Lindelöf degree of finite and countable products of scattered Lindelöf spaces were obtained. Furthermore, it was shown that the Lindelöf degree of the  $G_\delta$ -topology on a countable product of compact scattered spaces is no greater than the cardinality of the continuum.

To carry out the project further, set theoretic assumptions and techniques were required. Investigation in the field of set theory has led to new results. For example, under the generalized continuum hypothesis, it was shown that for limit cardinals  $\alpha$  with uncountable cofinality, the Lindelöf degree of the  $G_\alpha$ -topology on a countable product of compact scattered spaces is no greater than  $\alpha$ . There have also been results concerning products of  $\sigma$ -compact spaces.

Conjectures have been made about the  $G_\delta$ -topology on countable products of Lindelöf scattered spaces, but the positive results obtained thus far have been for very restricted cases.

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SURFACE SHIP SILENCING STRUCTURES - BORNE NOISE PATH IDENTIFICATION

Researcher: Associate Professor John S. Kalme

Sponsor: David Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The investigation is the basis for two classified reports:

1. Computer programs for structure-borne noise paths and source identification, using partial coherence spectral analysis; also for analysis of noise sources and paths on a frigate; and,
2. A new technique for propagation-delay estimation of flexural and traveling waves in steel structures, with applications to noise-path identification in ship structures.

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A SENSITIVITY ANALYSIS OF DETECTION TO VARIATIONS OF SOURCE LEVEL

Researcher: Associate Professor Arthur A. Karwath

Sponsor: Naval Sea Systems Command, (Antisubmarine Warfare  
Systems Project Office)

In this research, a continuation of a project started in 1978, a probabilistic model associated with the detection of acoustic energy is investigated. The work involves the study of new as well as modified signal processes. The project is classified.

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C\*-ALGEBRA COMPACTIFICATION OF SEMIDIRECT PRODUCTS OF SEMIGROUPS

Researcher: Assistant Professor Bao Ting Lerner

Sponsor: Naval Academy Research Council

This research is a continuation and expansion of an earlier Naval Academy Research Council project on the structure of semigroup compactifications of semidirect products of semitopological semigroups.

In the paper "Semigroup Compactifications of Semidirect Products" (Transactions of the American Mathematical Society, 265 (June 1981), 393-404) the investigator formulated necessary and sufficient conditions needed to insure that the F-compactification of the semidirect product could be decomposed into a semidirect product.

In order to apply these results to the weakly almost periodic case, the investigator demonstrated that amenability conditions had to be imposed on the C\*-algebras of functions on semidirect products. The object of this research is to obtain applications of these conditions to decomposition of wreath products, compactifications of transformation semigroups, and amenability properties of Von Neumann algebras.

\*\*\*\*\*

**APPLICATIONS OF STOCHASTIC ESTIMATION AND CONTROL THEORY**

Researcher: Assistant Professor Paul B. Massell

Sponsor: Naval Academy Research Council

Linear stochastic control models are systems of first-order ordinary differential (or difference) equations. They have been used to describe systems in engineering and the physical and biological sciences whenever linearity is thought to be a good approximation over a broad range of state variable values (global linearity). However many of the model's applications arise from the use of the variational technique called linearization about a trajectory, when linearity is assumed to hold only for small deviations from the nominal trajectory. The goal of these models is often the calculation of an optimal control vector or a best estimate of the state vector where optimal or best means minimizing a quadratic performance criterion.

A survey will first be made of areas where this model has been applied, such as navigational errors for submarines, optimal investment strategies in finance, immunological, and other biological control systems. Then the success of these models will be evaluated to determine the potential range of applicability of the linear model, when stochastic components should be used, and what techniques are feasible to overcome problems with observability, controllability, and stability. Specific open questions in some of the application areas mentioned above will also be investigated.

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**ADAPTIVE WELDING SYSTEMS**

Researcher: Associate Professor Peter A. McCoy

Sponsor: David Taylor Naval Ship Research and Development Center, Annapolis Laboratory

Heat sources moving along smooth curves in three-dimensional media are considered. Specific heat and thermal conductivity are non-linear functions of position and temperature. The resulting heat equation in the moving frame is written as a system of coupled non-linear equations that are solved by an iteration process. A high degree of accuracy is achieved, with the errors decaying rapidly (better than exponentially) as a function of the number of iterations.

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## DIOPHANTINE APPROXIMATIONS

Researcher: Assistant Professor Michael L. Robinson

Sponsor: Naval Academy Research Council

One objective of this project is to obtain better effective irrationality measures for certain algebraic numbers. The investigator hopes that some old ideas of Minkowski in the geometry of numbers will prove applicable.

A second objective is to consider two related open questions raised by R. Graham and G. Meyerson. Graham wanted a non-trivial lower bound for  $|\sqrt{n_1} \pm \sqrt{n_2} \pm \dots \pm \sqrt{n_k}|$  where  $\{n_i\}$  is an increasing set of positive integers. Meyerson asked for a non-trivial lower bound for  $|\zeta_1 + \dots + \zeta_p|$  where the  $\zeta_j$  are p-th roots of unity,  $p \geq 5$ . The investigator has now solved both problems with the aid of some unpublished results of Mignotte.

\*\*\*\*\*

EXTENSION OF THE  $\hat{A}$  CHARACTERISTIC CLASS TO SINGULAR SPACES

Researcher: Assistant Professor James M. Stormes

Sponsor: Naval Academy Research Council

A Riemannian manifold  $M$  with a Spin-structure possesses a characteristic cohomology class  $\hat{A}(M)$ , which generalizes the numerical invariant  $\text{Spin}(M)$ , defined to be  $\dim \ker D - \dim \text{coker } D$ , where  $D$  is the Dirac operator on  $M$ .

The objective of this research has been to find and characterize a family of singular spaces for which a generalization of the  $\hat{A}$  class may be defined.

The method has been to look for a decomposition of the variety into non-singular strata. The relation between the Todd and  $\hat{A}$  classes is well-understood in the non-singular case.

Two methods of obtaining such a decomposition have been investigated, but neither has proved to be correct. At least two other methods remain to be studied during the coming year.

\*\*\*\*\*

SPONSORED RESEARCH

MATHEMATICS DEPARTMENT

ODD UNIVALENT FUNCTIONS

Researcher: Assistant Professor Anna Tsao

Sponsor: Naval Academy Research Council

Let  $U = \{z: |z| < 1\}$  denote the unit disk and  $S$  the class of functions  $f$  analytic and univalent in  $U$  with  $f(0) = 0$  and  $f'(0) = 1$ . An important function in  $S$  is the Koebe function.

Closely related to the class  $S$  is the subclass  $T$  of odd univalent functions  $h$  in  $S$ . These have the form

$$h(z) = [f(z^2)]^{\frac{1}{2}} = z + c_3 z^3 + c_5 z^5 + \dots$$

where  $f$  is in  $S$ .

Bombieri used the theory of the second variation together with Loewner's method to prove that the Koebe function is a local maximum for the  $n$ -th coefficient. The investigator is developing similar techniques in the class  $T$  and hopes to show that the square root transform of the Koebe function is a local maximum for  $\operatorname{Re} \{c_{2n+1}\}$ .

In order to consider the extreme points and support points of  $S$ , extensive use has been made of Sniffer's boundary variation. The variation gives a differential equation describing the omitted set  $\Gamma$  of an extremal function in  $S$ . The investigator hopes to develop analogous techniques in the class  $T$  in order to obtain the desired geometric information about the omitted sets of extremal functions in  $T$ .

\*\*\*\*\*

A STUDY OF HOPF MAPS AND COMPOSITION OF QUADRATIC FORMS

Researcher: Assistant Professor JoAnn S. Turisco

Sponsor: Naval Academy Research Council

The problem under consideration is the study of the existence and classification of certain quadratic mappings of spheres whose form resembles that of the classical Hopf fibrations. This problem is closely related to one concerning composition of quadratic forms, which was studied during 1980-1981 under NARC funding.

The existence and classification of Hopf maps is studied, using various numerical invariants. For every quadratic mapping of spheres there is an associated quadratic form. This form is defined by integrating products of the coordinate functions of the map over the unit sphere. Quadratic form invariants, such as rank, determinant, signature, Hasse invariant, and Clifford algebra are computed. Certain relationships among these invariants give some insight into the existence of the quadratic mappings in various dimensions. Of particular interest are integral Hopf maps which give rise to rational forms. In this case, the invariants can be computed in terms of the dimensions of the spheres, and some results have been obtained concerning composition of forms. Work in this area is in progress.

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#### COMPUTER STUDY OF POINT DEFECTS IN SOLIDS

Researcher: Assistant Professor Peter J. Welcher

Sponsor: Naval Academy Research Council

Programs written by Major R. J. Kimble, USMC, and modified by the investigator model a finite portion of a fluorite-structured crystalline lattice at low temperatures. Previously the investigator studied rare earth dopants in the fluoride crystals  $RF_2$  ( $R = Ca, Sr, Ba$ ), calculating stabilities of various configurations, and the enthalpies and mechanisms of ion migration in such crystals. To extend this, some aspects of alkali metal dopants ( $Li, Na, K, Rb$ ) in  $CaF_2$  and  $SrF_2$  have now been modelled.

Work is underway in several areas. One aspect involves rare earth dopants in lead fluoride,  $PbF_2$ , and in strontium chloride,  $SrCl_2$ . Another area of computer modelling is the re-examination of the next-nearest-neighbor migration mechanism in rare earth doped  $RF_2$  (with  $R$  as above). This is necessary in spite of the close agreement of our enthalpies with those produced by the sophisticated HADES program of Harwell Labs in England, because both sets of enthalpies are higher than experimental values, possibly because of failure of the assumed symmetry. Pressure changes and migration enthalpies with alkali metal dopants are also being simulated.

A preliminary literature-search has begun on computer modeling of ion conduction in polymer crystals, of current interest because of recently discovered probable applications to batteries and to semiconductors.

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THE EVALUATION OF ZETA FUNCTIONS AT NEGATIVE INTEGERS

Researcher: Assistant Professor William E. Yancey

Sponsor: Naval Academy Research Council

The objective of this project is to obtain special values of zeta functions associated to totally real algebraic number-fields. This is accomplished by finding a polygonal cone fundamental domain in the totally positive coordinate octant under the multiplicative action of the totally positive unit group. The fundamental domain is then decomposed into basic simplicial cones determined by the lattice structure of the ring of integers. Each cone contributes a residue quantity to the value of the zeta function at negative integers. By properly combining terms it may be demonstratable that they yield a rational number with bounded denominator.

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ORTHOMODULAR GEOMETRIES AND THEIR COORDINATIZING SEMIGROUPS

Researcher: Assistant Professor Karen E. Zak

Sponsor: Naval Academy Research Council

The object of this project is to discover which Baer \*-semigroups coordinatize orthomodular geometries. The investigation to date has established that dimension \*-semigroups work. In particular, it has been shown that if the geometry satisfies a technical condition and  $l$  is finite, then the geometry can be coordinatized by a partially unitary dimension \*-semigroup.

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SEMI-BOOLEAN ALGEBRAS AND EMPIRICAL LOGIC

Researchers: Midshipmen 1/C Peter Haglich and Timothy Thomas

Adviser: Professor James C. Abbott

Sponsor: Trident Scholar Program

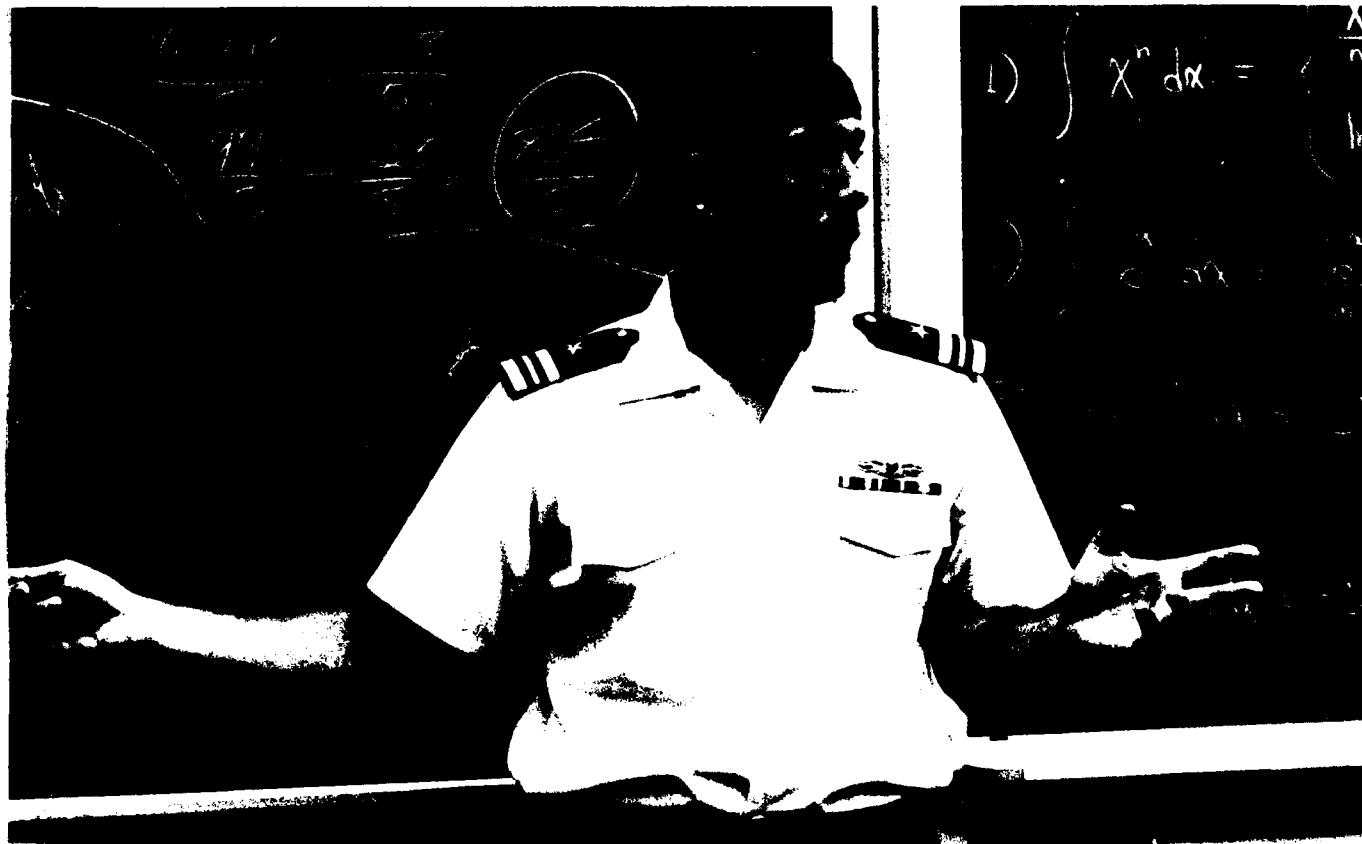
Semi-Boolean algebra is a generalization of classical Boolean algebra, a mathematical model proposed by Boole for classical logic. Empirical logic is a field which attempts to offer consistent interpretations to outcomes of physical experiments, largely in the area of quantum mechanics. Recently, it has been noted that the basic tool of empirical logic, the theory of

manuals, is a special type of semi-Boolean algebra. Investigations of the relationships between semi-Boolean algebra and empirical logic were pursued by Midshipmen Thomas and Haglich in their Trident projects.

Thomas's project developed in two directions. The first involved the design of a computer program to test when a specific semi-Boolean algebra satisfied the manual condition. The second resulted in the construction of examples of semi-Boolean manuals in the 'real' world outside of quantum physics. Its application to problems arising in navigation were particularly relevant.

Haglich's project emphasized the development of algebraic structure of dominated, atomic, semi-Boolean algebras satisfying the manual condition. New results in the algebra of manuals were established and applied to ring theory, particularly to Baer \*rings which are important in the theory of rings with operators arising in Hilbert spaces.

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RECONSTRUCTING FINITE MANUALS FROM THEIR EVENT STRUCTURES IN  
OPERATIONAL STATISTICS

Researcher: Assistant Professor Carol G. Crawford

The major objective of this work concerns a reconstruction problem of a mathematical theory relating to experiments in an abstract setting. This field, known as Operational Statistics, generalizes the conventional notion of sample spaces by providing a mathematical model for the simultaneous representation of the outcomes of a set of related random experiments.

A manual ( $X_{in}$ ), consisting of the operations involved in a collection of experiments, can be represented by a connected graph composed of complete graphs intersecting on one or more vertices. From the graph representing ( $X_{in}$ ) one can construct the event structure  $(D, l)$ .  $(D, l)$  is represented by a disconnected graph whose components are made up of stars and paths, where each line segment represents an operation, and the endpoints represent events which form a partition of the outcomes making up the operation.

Through a series of investigations into the structure of  $(D, l)$  the researcher has developed an algorithm to reconstruct the possible manuals which have  $(D, l)$  as their event structure. Further graph theoretic applications of this result are being studied.

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TOPOLOGICAL QUESTIONS ON THE SPECTRUM OF A RING

Researcher: Assistant Professor Charles C. Hanna

If  $A$  is a commutative ring with identity, then the prime spectrum of  $A$ ,  $\text{Spec } A$ , is the set of prime ideals of  $A$  with the topology determined by declaring every set of the form  $V(I)$  to be closed. (For an ideal  $I$  of  $A$ ,  $V(I)$  is the set of all prime ideals which contain  $I$ .) If  $X$  is a subspace of  $\text{Spec } A$  and  $Y$  is the set of all prime ideals of the polynomial ring  $A[x]$  (or more generally of any commutative  $A$ -algebra  $B$ ) which contract to elements of  $X$ , then certain topological properties of  $X$  are preserved in  $Y$ .

Joint work with Jon L. Johnson of Elmhurst College has shown that if  $X$  is noetherian (satisfies the ascending chain condition on open subsets) then  $Y$  is noetherian. This and other results have been applied to the relationship between the spectrum and graded spectrum of a graded ring.

Research is continuing on related questions. For example, if every element of X is an intersection of maximal elements of X, then the same is true for Y. It is not yet clear what the proper analogue of this result is for graded rings.

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#### SOLVING THE INITIAL STATE (i.e. SINGULARITY) PROBLEM

Researcher: Associate Professor Robert A. Herrmann

In this research, a recursively constructed model for all known classification schemes by means of large flexible matrices is investigated in the following manner. All known mathematical models for the behavior or natural phenomena are nonstandardly embedded in to a model for ZFA + AC, where A is isomorphic to the real numbers. A background universe, the D-universe, is constructed from the set of M-galaxies and the standard models are mediated from the D-universe through application of internal supercontinuous, supersmooth D-mappings. Such processes as photon absorption, particle creation and annihilation, spontaneous creation of virtual particles and all other such interactions are mediated by the D-mappings. The initial state (i.e. singularity) is explicitly modeled by the M-galaxies, and this state may be analyzed by application of the known properties for ordered divisible groups, modules and vector spaces coupled with the properties of the infinite and infinitesimal nonstandard real numbers. This model allows for local irregularities and possible masking processes.

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#### INTERPLAY BETWEEN TOPOLOGY AND GEOMETRY

Researcher: Assistant Professor Mark D. Meyerson

The objective is to study, unify and solve several problems which are of special interest because they are simultaneously topological and geometrical, and to consider geometric approaches to topological problems. Examples of results in these areas include a geometric proof of the Borsuk-Ulam Theorem, an example of tame knots which cannot be linked by straight lines, Roger Fenn's Table Theorem, results on dilations, and placing hyperbolic geometry on 3-manifolds.

Several results, extending the Table Theorem, have been found. In addition, the concept of "intrinsic metric" for a metric space has been developed (later developed by Karol Borsuk).

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INDEPENDENT RESEARCH

MATHEMATICS DEPARTMENT

ON GENERALIZATIONS OF FUNCTIONS WITH BOUNDED ROTATION

Researcher: Assistant Professor Edward J. Moulis, Jr.

This investigation applies recent results in function theory due to Lehto and to Kirwan and Schober to the Schwarzian derivatives of certain classes of analytic functions. These will be used to refine univalence results given in the researcher's previous papers.

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MATHEMATICAL MODELING

Researcher: Associate Professor Thomas J. Sanders

The objective of this project is to gain experience in mathematical modeling. Three models are presently being investigated.

The first is a Monte Carlo model of an encounter between an attacking aircraft and a defensive ground battery. The second is a discrete model of an encounter between two aircraft. The third is a model of an elevator system. The first model has been written and validated. The second and third are currently under construction.

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SUMMARY OF RESEARCH ACTIVITIES ACADEMIC DEPARTMENTS  
1981-1982(U) NAVAL ACADEMY ANNAPOLIS MD W L HEFLIN

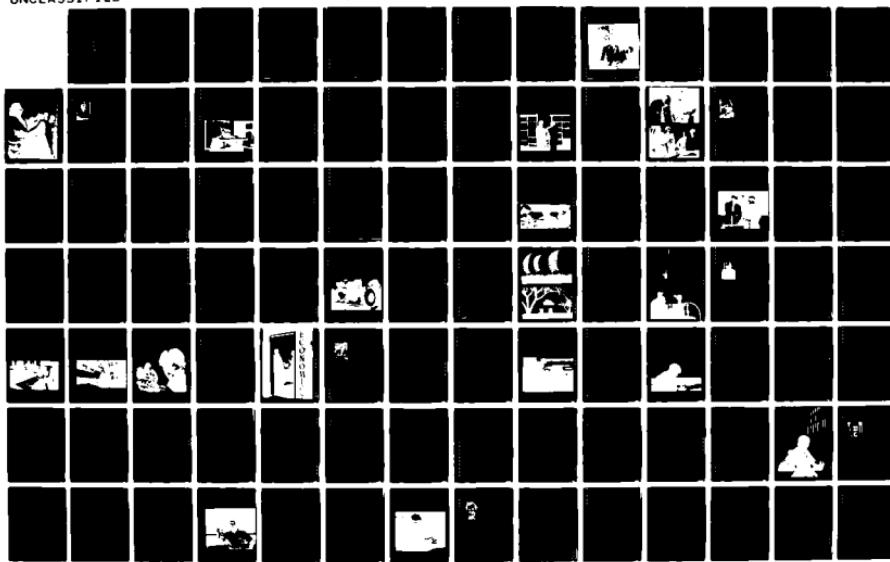
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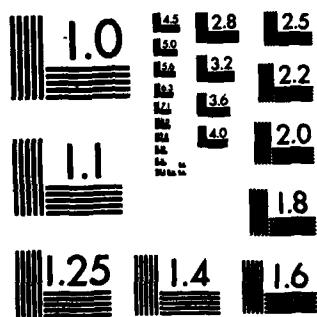
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MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

BAILEY, Craig K., Assistant Professor, "Points by Degree and Orbit Size in Chemical Trees I," The Theory and Applications of Graphs, Wiley-Interscience, 1981, pp. 27-43.

Various functional relations are derived for the enumeration of d-trees, whose points have maximum degree d. An asymptotic analysis of these equations leads to the determination of the distribution of points by degree and orbit size in large random trees. Note that when d = 4, these trees represent the carbon skeleton of alkanes. The resulting conclusions form the initial stage of an investigation of averages of certain properties of trees. These averages, when properly weighted, are of central importance in the study of collections of large molecules formed, for example, as an equilibrium distribution by some chemical reaction process.

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GEWAND, Marlene E., Assistant Professor, "Covering Properties of Linearly Ordered Topological Spaces and their Products," Topology and Order Structures, Part I, Tract 142, H. R. Bennett and D. L. Lutzer, ed. Amsterdam: Mathematical Centre Tracts, 1981, pp 119-132.

While the Tychonoff theorem asserts that any product of compact spaces is compact, other covering properties, paracompactness and the Lindelöf property in particular, fail to be productive even in finite products. The question of when such properties are productive has been asked many times, and particular cases have been answered. In this paper, the case when one of the factors is a linearly-ordered topological space (LOTS) is considered. The technique of defining an equivalence relation on a LOTS and then examining the resulting quotient space has proven to be useful in determining properties of the LOTS. This technique is used to examine the covering properties of LOTS and of products of LOTS with other spaces.

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HANNA, Charles C., Assistant Professor, "Basic Elements in Graded Rings," Communications in Algebra, 9(1981), 1547-1563.

The central result of the paper is a generalization to graded rings and graded modules of the Eisenbud-Evans theorem on basic elements.

Let  $A = A_0 \oplus A_1 \oplus \dots$  be a graded ring, finitely generated as an  $A_0$ -algebra by elements of  $A_1$ . Let  $M$  be a finitely generated graded  $A$ -module. If  $P$  is a prime ideal of  $A$ , let  $k(P)$  denote the quotient field of  $A/P$ . If  $M'$  is a submodule of  $M$ , the dimension of the image of  $M' \otimes k(P)$  in  $M \otimes k(P)$  is written  $b(P, M', M)$ . If  $X$  is a subset of  $\text{Proj } A$ , the collection of homogeneous prime ideals of  $A$ , and  $P$  is in  $X$ , then the  $X$ -dimension of  $P$  is the length of the longest chain of prime ideals in  $X$  extending up from  $P$ . If a homogeneous element  $m$  of  $M'$  satisfies  $b(P, Am, M) = 1$  for every  $P$  in  $X$ , then  $m$  is basic in  $M$  on  $X$ .

Theorem: If for each  $P$  in  $X$   $b(P, M', M)$  exceeds the  $X$ -dimension of  $P$ , then  $M'$  contains a homogeneous element  $m$  which is basic in  $M$  on  $X$ .

The consequences of this result include a theorem on locally free sheaves on quasi-projective schemes over noetherian rings.

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PUBLICATIONS

MATHEMATICS DEPARTMENT

HERRMANN, Robert A., Associate Professor, "Godel's Theorem Misunderstood," Journal of the American Scientific Affiliation, 33 (December 1981), 255.

This note discusses the usual philosophical misunderstanding of Godel's incompleteness theorem. It points out that Godel's theorem refers to recursively-presented axion systems and does not apply to nonformalizable intuitive theories.

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HERRMANN, Robert A., Associate Professor, "Rigorous Infinitesimal Modeling," Math. Japonica 26 (1981), 461-465.

In this note, a rigorous procedure for the derivation of the various differential equations associated with elementary mechanics is presented. These results solve the d'Alembert-Euler controversy associated with applied modeling. This controversy concerns the development of a derivation argument which is not based upon the simple axiomatic acceptance of the differential equation as a model for the physical phenomenon nor some vague approximation concept but rather is based upon a rigorous foundation.

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HERRMANN, Robert A., Associate Professor, "The Miraculous Model," Monograph #100, The Institute for Mathematical Philosophy, 1982.

The major purpose for this article is to demonstrate how it is possible to mathematically construct a semantically and, thus, logically consistent model for the sudden appearance concept as described by Lewis. Moreover, this article enlarges upon and refines various important notions which were briefly mentioned in the article, "The Reasonableness of Metaphysical Evidence."

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PUBLICATIONS

MATHEMATICS DEPARTMENT

HERRMANN, Robert A., Associate Professor, "The Reasonableness of Metaphysical Evidence," Journal of the American Scientific Affiliation 34 (March 1982), 17-23.

This article explains how a recent discovery in the science of mathematical logic has been employed to construct a scientific model for many of the major concepts in Christian doctrine. These results give strong scientific evidence that the basic foundation for the religious philosophy of Marxists, secular humanists, atheists, and millions of individuals who reject Christianity is logically incorrect. The logical incorrectness of this foundation is grounded on the fact that it has been scientifically established that this foundation is based upon a mathematically refutable premise.

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McCOY, Peter A., Associate Professor, "Singularities of Solutions to Linear Second Order Elliptic Partial Differential Equations With Analytic Coefficients by Approximation Methods," Pacific Journal of Mathematics, 91, (1980) 397-406.

The canonical linear second order elliptic partial differential equation with real-valued coefficients on the closure of the unit disk is considered. This disk is taken as the initial domain of definition of a unique real-valued solution. A local Chebyshev approximation scheme is given by which global information on the structure and location of the singularities is found for the analytic continuation of the solution to the plane. This follows from an error analysis of best approximates taken over certain families of regular solutions whose singularities are located in the complement of the disk.

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McCOY, Peter A., Associate Professor, "Approximation of Generalized Biaxially Symmetric Potentials on Certain Domains," Journal of Mathematical Analysis and Applications, 82 (1981), 463-469.

Let  $F$  be a real-valued generalized biaxially symmetric potential in  $L^p(D)$  ( $p \geq 2$ ). The set  $D$  is a member of a certain class of open convex sets. Necessary and sufficient conditions are given in terms of the convergence of the sequence of best harmonic polynomial approximates to  $F$  in  $L^p(D)$  so that  $F$  harmonically continues as an entire function GBASP. The order and type of  $F$  are determined from both the convergence rate of the approximating sequence and the transfinite diameter of the supporting set  $D$ .

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PUBLICATIONS

MATHEMATICS DEPARTMENT

McCOY, Peter A., Associate Professor, "Best  $L^p$  Approximation of Generalized Biaxisymmetric Potentials," Proceedings of the American Mathematical Society, 79, (1980), 435-440.

Let  $F$  be a real-valued generalized biaxisymmetric potential (GBASP) in  $L^p(p \geq 1)$  on the open unit sphere about the origin. Convergence of a sequence of best harmonic polynomial approximates to  $F$  in  $L^p$  identifies those  $F$  that harmonically continue as entire function GBASP and determines their order and type as defined in classical analytic function theory.

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McCOY, Peter A., Associate Professor, "Recapturing Solutions of an Elliptic Partial Differential Equation," Spectral Theory of Differential Operators, Ian Knowles and Roger Lewis (editors): New York: North-Holland Mathematical Studies 55 (1981), 319-325.

The paper concerns the recovery of select regular period solutions of a Schrodinger equation from data averaged at sets of equally spaced points distributed along the boundary of a disk, an arc of the boundary and the boundaries of certain conformally equivalent domains to the disk.

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MEYERSON, Mark D., Assistant Professor, "Balancing Acts," Topology Proceedings, 6 (1981), 59-75.

A history is given of problems involving placing a geometric object on a topological object. Such problems include work of Emch, Schnirelman, and Jerrard in placing the vertices of a square on a simple closed planar curve. Another type of result, the work of Levy and Hopf, is balancing a horizontal segment on the graph of a continuous function of one variable, and, more recently, work of Fenn and Kronheimer in placing a square table on a hill. Several new related results are described.

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MEYERSON, Mark D., Assistant Professor, "Convexity and the Table Theorem," Pacific Journal of Mathematics, 97 (1981), 59-61.

In "The Table Theorem," Roger Fenn proves that one can "balance" a square "table" on any "hill" with convex support and suggested relaxing the convexity assumption. It is shown that this hypothesis is necessary.

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PUBLICATIONS

MATHEMATICS DEPARTMENT

MEYERSON, Mark D., Assistant Professor, "Every Power Series is a Taylor Series," American Mathematical Monthly, 88 (1981), 51-52.

In calculus one learns to define a Taylor series for any function with all its derivatives defined at a point. (Then convergence is studied. The standard example,  $y = \exp(-1/x^2)$ , shows that the Taylor series may fail to converge to the original function.) The following question naturally arises: Is a given power series the Taylor series for some function? It is shown that the answer is always yes.

\*\*\*\*\*

MEYERSON, Mark D., Assistant Professor, "Local Dilations," Illinois Journal of Mathematics, 25 (1981), 337-357.

A local dilation is an embedding of a metric space which "stretches" in all small regions. It is shown that a local dilation from a closed manifold with any "reasonable" metric into itself is an isometry in the intrinsic metric. Also, a strictly starlike region in a hyperplane in Euclidean n-space can be "pushed-out" along a right cylinder (and not along a slanting cylinder) with a local dilation. Convexity properties and fixed-point properties are considered, and the concept of path-metric or intrinsic metric is introduced. Many counter-examples are included.

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SANDERS, Thomas J., Associate Professor, "Induced CG-shape maps," Proceedings of the International Conference on Geometric Topology, Warsaw, Poland: Polish Scientific Publishers, 1980, pp. 377-379.

It is shown that each compactly generated shape map from a paracompact, locally compact Hausdorff space into an absolute neighborhood retract is induced by a continuous function. An application of this result is the following: two locally compact connected CW-complexes having the same Borsuk weak shape also have the same homotopy type.

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PUBLICATIONS

MATHEMATICS DEPARTMENT

TURNER, John C., Assistant Professor, "Quick and Dirty Statistical Packages," Proceeding of the Statistical Computing Section of the American Statistical Association, 1981, pp. 135-137.

A method is presented for writing generalized statistical packages in Fortran. Primarily, the method exploits the way arrays are stored in Fortran. The method can be implemented by any competent programmer and is quite useful, even for specialized research projects.

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WELCHER, Peter J., Assistant Professor, (co-author), "Clustering in Rare-earth Doped Alkaline Earth Fluorides," J. Phys. C: Solid State Physics, 14 (1981), 3557-3574.

Audio frequency capacitance and conductance measurements have been carried out for various rare earth dopants in calcium fluoride, strontium fluoride, and barium fluoride. Computerized non-linear least squares data fitting leads to graphs of the imaginary part of the complex dielectric constant versus temperature. The peaks in these graphs represent relaxations due to the formation of new dopant configurations. Where possible this paper identifies the configuration associated with each peak, comparing the relaxations with those seen using other experimental techniques, and summarizing what is known. Computer simulation of the 'gettered' 2:2:2 cluster suggests that one peak seen in each of  $\text{CaF}_2$  and  $\text{SrF}_2$  is probably due to this defect structure. Conclusions based on computer modeling of the nearest neighbor (NN) and next-nearest-neighbor (NNN) clusters are given.

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WELCHER, Peter J., Assistant Professor, (co-author), "The Relation Between Bound and Free Ion Motion in Some Fluorides," Solid State Ionics, 5 (1981), 585-588.

Audio frequency complex impedance measurements for sodium and lanthanum-doped lead fluoride and for calcium-doped lanthanum fluoride are presented. Computer non-linear least-squares data fitting is then used to determine experimental values for the enthalpies of migration of the bound charge. Useful information concerning ion transport can be obtained as bound vacancy motion simulates free vacancy motion. Activation enthalpies for the motion of bound and free interstitials are also discussed in relation to recent activation volume data for the motion of bound interstitials. Estimates of free interstitial migration volumes



PRESENTATIONS

MATHEMATICS DEPARTMENT

CRAWFORD, Carol G., Assistant Professor, "Math Anxiety and the Adult Student," Adult Education Program, Caldwell College, New Jersey, 22 January 1982.

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GAGLIONE, Anthony M., Assistant Professor, "Some Commutator Identities," Annual Summer Meeting of American Mathematical Society, Pittsburgh, Pennsylvania, 19 August 1981.

\*\*\*\*\*

GAGLIONE, Anthony M., Assistant Professor, "A Theorem in the Commutator Calculus," Sectional Meeting of Mathematical Association of America, Washington, D. C., 14 November 1981.

\*\*\*\*\*

GAGLIONE, Anthony M., Assistant Professor, "The Lower Central Series of  $\langle x, y; x^{25} = y^{25} = 1 \rangle$ ," Sectional Meeting of American Mathematical Society, Bryn Mawr, Pennsylvania, 17 March 1982.

\*\*\*\*\*

HANNA, Charles C., Assistant Professor, "Prime Ideals in Graded Rings," Conference on Commutative Algebra, Virginia Commonwealth University, Richmond, Virginia, 6 November 1981.

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HANNA, Charles C., Assistant Professor, "Differential Equations and Topological Algebra," Mathematics Department Colloquium Series, George Mason University, Fairfax, Virginia, 18 February 1982.

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HANNA, Charles C., Assistant Professor, "Differential Equations and Topological Algebra," Mathematics Department Colloquium Series, Howard University, Washington, D. C., 11 March 1982.

\*\*\*\*\*

HERRMANN, Robert A., Associate Professor, "Mathematical Philosophy - 1981 Status Report," Annual Meeting of the American Scientific Affiliation, St. Davids, Pennsylvania, 14 August 1981.

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PRESENTATIONS

MATHEMATICS DEPARTMENT

HERRMANN, Robert A., Associate Professor, "Preconvergence Compactness and P-closed Spaces," Spring Topology Conference, U. S. Naval Academy, 11 March 1982.

\*\*\*\*\*

KAPLAN, Gail, Assistant Professor, "The Game of Logic," Sectional Meeting of Mathematical Association of America, Washington, D.C., 13 November 1981.

\*\*\*\*\*

MASSELL, Paul B., Assistant Professor, "The New Applied Mathematics - What are the Important Techniques?," Annual Summer Meeting of American Mathematical Society, Pittsburgh, Pennsylvania, 19 August 1981.

\*\*\*\*\*

McCoy, Peter A., Associate Professor, "Near Best Approximate Solutions of Elliptic Partial Differential Equations in Two Dimensions," Annual Winter Meeting of the American Mathematical Society, Cincinnati, Ohio, 13 January 1982.

\*\*\*\*\*

McCoy, Peter A., Associate Professor, "Converse Initial Value Problems for a Class of Heat Equations," 1982 Dundee Conference on Ordinary and Partial Differential Equations, Dundee University, Dundee, Scotland, 23 March 1982.

\*\*\*\*\*

PENN, Howard L., Associate Professor, "The Heat Equation on a Metal Bar with Radiating Ends," Sectional Meeting of Mathematical Association of America, Washington, D.C., 14 November 1981.

\*\*\*\*\*

REED, George M., Visiting Professor, "Submetrizable Topologies on the Ordinals," NATO Conference on Linear Topological Spaces, Amsterdam, The Netherlands, 17 August 1981.

\*\*\*\*\*

REED, George M., Visiting Professor, "Topological Characterizations of Surface in Digital Images," Auburn University, 17 October 1981.

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PRESENTATIONS

MATHEMATICS DEPARTMENT

REED, George M., Visiting Professor, "Geometric Topology and Computer Vision," University of Houston, 3 February 1982.

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REED, George M., Visiting Professor, "Point vs Set Topology," Oxford University, Oxford, England, 25 May 1982.

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REED, George M., Visiting Professor, "Geometric Topology and Computer Vision," University of London, London, England, 27 May 1982.

\*\*\*\*\*

REED, George M., Visiting Professor, "Point vs Set Topology," University of London, London, England, 26 May 1982.

\*\*\*\*\*

ROBINSON, Michael L., Assistant Professor, "Rational Approximations to  $\zeta(3)$ ," Number Theory Seminar, University of Michigan, Ann Arbor, Michigan, 9 July 1981.

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STORMES, James M., Assistant Professor, "How Many Lines Intersect Four Given Lines? An Introduction to Enumerative Geometry," Sectional Meeting of Mathematical Association of America, Washington, D.C., 13 November 1981.

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TURNER, John C., Assistant Professor, "Calculating the Digits of  $e$ ," Sectional Meeting of Mathematical Association of America, Washington, D.C., 17 April 1982.

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TURNER, John C., Assistant Professor, "Quick and Dirty Statistical Packages," National Bureau of Standards, Washington, D.C., 12 November 1981.

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PRESENTATIONS

MATHEMATICS DEPARTMENT

WARDLAW, William P., Assistant Professor, "Pegjump Games,"  
Fall Meeting of the Mathematical Association of America,  
Washington, D.C., 13 November 1981.

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WELCHER, Peter J., Assistant Professor, "Free and Bound Ion Motion," (film/TV tape), NATO Advanced Study Institute, Lannion, France, 7 July 1981.

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WELCHER, Peter J., Assistant Professor, (co-author), "Pressure Dependent Electrical Properties of Some Fluorides," 13th Washington Area High Pressure Colloquium, Naval Research Laboratory, Washington, D.C., 13 November 1981.

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WELCHER, Peter J., Assistant Professor, (co-author), "Computer Calculation of the Effect of Pressure on Motional Enthalpies in the Alkaline Earth Fluorides," American Physical Society, Dallas, Texas, 8-12 March 1982.

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WELCHER, Peter J., Assistant Professor, (co-author), "Dielectric Spectroscopy in Rare Earth Doped Lead Fluoride," 2nd European Conference on Solid State Chemistry, The Netherlands, 7-9 June 1982.

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## OCEANOGRAPHY DEPARTMENT

*Commander John P. Simpson, USN, Chairman*



During the 1981-1982 academic year, faculty research (in a broad range of atmospheric and oceanographic areas) was regularly undertaken by both civilian and military members of the Oceanography Department. Not only does this research provide the opportunity for the faculty to keep abreast of current technology and theory, but it also serves as a basis for qualified midshipmen to undertake related research projects, particularly those dealing with the Chesapeake Bay, where their work can be supported by the Departmental research vessel.

Funding for these research activities has been available from a number of sources, including grants from or contracts with the Defense Mapping Agency, Naval Air Systems Command, Naval Environmental Prediction Research Facility, Office of Naval Research, Naval Sea Systems Command, and the Naval Academy Research Council.

Specific areas of research activity with the Department include but were not limited to sedimentation processes and properties, light attenuation, bioluminescence, estuarine ecology, marine biofouling, dredging, environmental effects on electro-optic systems, climatology, statistical weather forecasting, and remote sensing.

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SPONSORED RESEARCH

OCEANOGRAPHY DEPARTMENT

CENOZOIC DEVELOPMENT OF THE SOUTHEAST GEORGIA EMBAYMENT

Researcher: Associate Professor Douglas W. Edsall

Sponsor: Naval Academy Research Council

The location on adjacent high-resolution seismic-reflection profiler records of bands of erosional features, characterized by channels and rugged pits cut into the numerous regional unconformities in the Embayment, has enabled the location of the Gulf Stream during Cenozoic times to be mapped. The migration of the axis of the Gulf Stream between two extreme flow-paths has been related to the global sea level curve for the Cenozoic. Furthermore, it has been recognized that these shifts in location of the axis of the Gulf Stream have had a significant impact on the distribution, composition and thickness of Cenozoic deposits in the Embayment.

The predecessor of the Gulf Stream, the Suwannee Current, flowed through the Suwannee Strait across the Florida Platform into the Atlantic Ocean from the Gulf of Mexico. Deposits of the Suwannee Current have been recognized in the western Blake Basin. This accumulation of sediments resulted when the Suwannee Current entered the deeper waters of the Atlantic Basin. The current then continued eastward around the Cretaceous shelf edge, the Charleston Bump.

While depositional evidence for the Suwannee Current exists, erosional evidence, such as that found in the Embayment and related to the Gulf Stream, has not been reported to date for Paleocene and Eocene times. The Cretaceous erosional channel is present on CDP records. The original profiler records, taken parallel to the coastline, have been reexamined to locate erosional evidence for the Paleocene and Eocene position of the Suwannee Strait and Current. This has not been a simple task, because of the shallow water depths and the presence of multiples.

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AIR/SEA INTERACTION CONDITIONS IN THE DENMARK STRAIT

Researcher: Associate Professor John W. Foerster

Sponsor: Naval Academy Research Council, Office of Naval Research,  
Explorers Club, Naval Oceanographic Office

This study proposed to gather knowledge of whale activity relative to subtle oceanic conditions such as wind stress and forage biota activity. An intense 35-day oceanographic cruise in the Denmark Strait forms the core of the data acquisition and hypothesis testing. The grant request is based on the hypothesis that wind from the north through east to south directions induces mass water movements across the Island Shelf of Iceland. During May and June this stimulates biological production of forage biota attracting feeding whales. Environmental satellites and a towed data-collecting vehicle will be incorporated into the study.

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SPONSORED RESEARCH

OCEANOGRAPHY DEPARTMENT

**STORM SURGE STUDY FOR KING'S BAY SUBMARINE SUPPORT BASE, GEORGIA**

**Researcher:** Professor John F. Hoffman

**Sponsor:** Officer in Charge of Construction - Trident Submarine Support, Kings Bay, Georgia

Problems involved in shoaling in the waterways leading to King's Bay Submarine Support Base, necessitated closing investigation in order to estimate the future annual maintenance-dredging needed to maintain satisfactory channel conditions. Associated problems such as dredge spoil-disposal require evaluation. In order to reduce the cost of maintenance-dredging, advance maintenance-dredging also bears looking into.

This project was a series of studies designed to investigate the various aspects of the shoaling problem. Where possible the cost of each program was estimated.

Of the 43 days allotted to the project, 40 percent of the time (17 days) was spent traveling to obtain background information in order to outline these programs and arrange cooperative programs.

State and Federal Government agencies contacted regarding these programs include: N.O.A.A., N.O.S., U.S. Geological Survey (U.S.G.S.), Defense Mapping Agency (D.M.A.), University of Georgia Marine Science Center, (COE), Waterways Experiment Station (W.E.S.), Naval Environmental Prediction Research Facility (NEPRF), and the Savannah District of the Corps of Engineers.

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**OPTICAL PROPERTIES OF COASTAL WATERS**

**Researcher:** Professor Jerome Williams

**Sponsor:** Defense Mapping Agency

Aiming toward the development of a relationship between the diffuse light-loss coefficient ( $k$ ) and the beam attenuation coefficient ( $c$ ), additional data were accumulated and analyzed. These data show a rather well-defined relationship not only between  $c$  &  $k$  but also between  $c$  and the Secchi Disc Reading &  $k$  and the Secchi Disc Reading.

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**RESEARCH COURSE PROJECTS**

**OCEANOGRAPHY DEPARTMENT**

**FATE OF TRACE-METALS IN COASTAL WATERS**

Researcher: Midshipman 1/C Richard Clyborne

Adviser: Professor Jerome Williams

Sponsor: National Oceanic and Atmospheric Administration

This paper deals with the fate of trace-metals in coastal and estuarine waters. A broad approach to the sources and methods of dispersion is presented, while the contamination of sediments is examined in greater detail. The subject of toxicity is discussed at the end of the paper with an explanation of the levels found in trace-metal analysis included.

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**CHARACTERISTICS OF BIOLUMINESCENCE**

Researcher: Midshipman 1/C Kristin Collins

Adviser: Professor Jerome Williams

Sponsor: Defense Mapping Agency

Using the knowledge that bioluminescent phytoplankton are usually active when disturbed, an airborne observer can locate fish from bioluminescent disturbances in the water. This technique has obvious applications in Naval operations concerning submarine detection and in other systems. The Navy's interest in bioluminescence is to determine the source level (initial intensity) of the emissions, together with the wavelengths most commonly encountered. These findings must be correlated with the characteristics of the laser systems in question to determine the extent of interference, if any, with operations that can be expected. To do this the level of laser energy at typical depths of penetration (usually ten to fifty meters) under water has led to research in the area of ocean bioluminescence also. The object of such research is to find how, if at all, the actions of bioluminescent plankton in the waters would interfere with such a system.

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RESEARCH COURSE PROJECTS

OCEANOGRAPHY DEPARTMENT

EVALUATION OF CHESAPEAKE BAY STRIPED BASS FISHERIES

Researcher: Midshipman 1/C Jeffrey L. Mahon

Adviser: Associate Professor John W. Foerster

Striped bass fisheries in the Northern Chesapeake Bay are evaluated. Loss of harvestable populations are presented and an analysis of management is noted.

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RELATIONSHIP BETWEEN MINCHINIA NELSONI AND PRECIPITATION  
1959-1975 IN THE JAMES RIVER

Researcher: Midshipman 1/C Matthew T. Scassero

Adviser: Professor Jerome Williams

The sporozoan Minchinia nelsoni (a.k.a. MSX) has caused epizootics in the oyster population in the Chesapeake Bay since 1959. This pathogen is profoundly affected by environmental factors, chief among them being salinity. A relationship between the prevalence of MSX in dead oysters and rainfall can be derived from existing data in these two areas. This relationship takes the form of a one-year delay in the effect of rainfall on MSX.

The study area was limited to the James River for two reasons. First, was the availability of data for this region, both of precipitation and of MSX prevalence. Second, this would limit the study to one drainage system, ensuring the confidence of precipitation relationships.

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RESEARCH COURSE PROJECTS

OCEANOGRAPHY DEPARTMENT

A PILOT STUDY OF A SHORT-RANGE STATISTICAL FORECAST PROCEDURE  
FOR WASHINGTON NATIONAL AIRPORT

Researcher: Midshipman 1/C Shawn W. Stroud

Adviser: Lieutenant Commander Fred C. Zeile III, USN

Since the advent of numerical atmospheric models, meteorological forecasting has experienced a quantum-level increase in accuracy in the twenty-four to seventy-two hour range. However, short-term (one to twenty-four hour) forecast accuracy has improved very little. In an attempt to fill this void, a statistical short-range forecast procedure, the generalized equivalent Markov Matrix (Gemtrix), was developed. This program was developed specifically for Washington National Airport and was tested using historical data.

In the test, data containing forty cold frontal passages were utilized. Heidke skill-scores were computed for each forecast. In addition, for each Gemtrix forecast produced, a persistence forecast was made and corresponding Heidke skill-score determined. Overall the Gemtrix program demonstrated enough significant skill over chance to make further research into the program concept worthwhile. At its present level, however, the Gemtrix program would be of little help to the forecaster since persistence provides forecasts with approximately the same accuracy.

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A STUDY OF THE RELATIONSHIPS BETWEEN THREE OPTICAL PARAMETERS  
OF THE CHESAPEAKE BAY

Researcher: Midshipman 1/C William Archer Wright

Adviser: Professor Jerome Williams

Sponsor: Defense Mapping Agency

Using data obtained from three sources in the Chesapeake Bay, the attenuation and extinction coefficients are compared with the Secchi depth and with each other. The correlation between the attenuation coefficient and Secchi depth is 0.94, and the correlation between the extinction coefficient and Secchi depth is 0.78. In the attenuation vs. extinction coefficient study, the correlation is 0.83. Using a linear regression, empirical equations are developed with which one can predict any two parameters by knowing the third.

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PUBLICATIONS

OCEANOGRAPHY DEPARTMENT

HOFFMAN, John F., Professor, "Sedimentation Problems in U. S. Navy Harbors," ONR/NAVFACENGCOM Sponsored Seminar at Scripps Institution of Oceanography, June 1981.

Sedimentation problems in six Navy-connected harbors are discussed. These harbors are Alameda, California, Naval Air Station; Charleston, South Carolina Naval Shipyard and Naval Station; Mayport Naval Air Station; Norfolk Naval Station; North Island Naval Air Station; and Pensacola Naval Air Training Station.

Also discussed are problems of grounding of deep-draft vessels during times of extremely low tidal stages.

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PRESENTATIONS

OCEANOGRAPHY DEPARTMENT

FOERSTER, John W., Associate Professor, "Charting and Geodesy Research at the U. S. Naval Academy," Arlington, Virginia, November 1981.

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FOERSTER, John W., Associate Professor, "Fin Whales in the North Atlantic," Biennial Conference of Marine Mammology, San Francisco, December 1981.

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WILLIAMS, Jerome, Professor, "M,C, & G Research at the U.S. Naval Academy," Annual Defense Mapping Agency Meeting, Bay St. Louis, Mississippi, December 1981.

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WILLIAMS, Jerome, Professor, "Marine Pollution: Scientific or Political Problem?", presented at May meeting of the Washington Chapter of the Marine Technology Society, U. S. Naval Academy, 11 May 1982.

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WILLIAMS, Jerome, Professor, "Trend Study of Chesapeake Bay Transparency: 1959-1975," 1981 Meeting of the Estuarine Research Federation, Salishan, Oregon, November 1981.

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WILLIAMS, Jerome, Professor, "The Oceanic Environment of Marine Organisms," 1982 March of Dimes Convocation, 5 March 1982, Baltimore, Maryland.

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## PHYSICS DEPARTMENT

*Professor Gerald P. Calame, Chairman*



Research in the Physics Department is encouraged for three reasons: it contributes towards a deeper understanding of the workings of the physical universe; it maintains faculty expertise; and it gives midshipmen opportunities to gain direct appreciation of both the joys and the difficulties of research through participation in research courses and in Trident Scholar projects. Research in areas with possible Naval applications are particularly encouraged.

The ongoing research in the Department reflects the wide range of expertise in the Department's faculty. Present activities include studies in Acoustics,

Computer-Assisted Education, Electric and Magnetic Properties of Materials, Fiber Optics, Laser Optics and Technology, Magnetic Signatures of Ships, Radiation Effects in Solids, Solar-Energy Studies, Solar System Astronomy, and Solid-State Physics, with the Solid-State Physics group being especially active.

This year, the Department's research efforts were supported by the David Taylor Naval Ship Research and Development Center, the Department of Energy, the National Aeronautics and Space Administration, the National Bureau of Standards, the Naval Research Laboratory, the Naval Academy Research Council, and the Naval Sea Systems Command.

Midshipmen majoring in physics are encouraged to participate in the Department's research program, either through the 490-series or through the Trident Scholar Program. It should be noted that two of the seven Trident Scholars for the year were Physics Majors.

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SPONSORED RESEARCH

PHYSICS DEPARTMENT

**ACOUSTIC SPECTROSCOPY**

**Researcher:** Associate Professor Donald W. Brill

**Sponsor:** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

Echoes of acoustic waves reflected from elastic targets carry within them certain resonance features caused by the excitation of the eigen vibrations of the target. By means of a suitable background subtraction, it is possible to isolate the target's spectrum of resonances. This resonance-spectrum characterizes the target just as an optical spectrum characterizes the chemical element or compound that emits it. Extracting the resonance information from the echo allows the possibility of identifying the target as to its size, shape, and composition. This is illustrated here by studying the dependence of the resonance-spectra of fluid targets in vacuo upon changes of target shape. The target shapes are varied here from spheres to prolate spheroids and finite-length cylinders. The resulting "acoustic spectroscopy" generates the same type of level scheme as in optics, and it may thus be used for solving some aspects of the "inverse scattering problem" (i.e., the problem of an identification of target shapes from the returned echoes).

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**INFRARED TRANSMISSION OF ION-IMPLANTED SEMICONDUCTORS**

**Researcher:** Assistant Professor Francis D. Correll

**Sponsor:** Naval Research Laboratory

This work is part of a continuing study of the infrared (IR) transmission of ion-implanted semiconductors. The long-range goal of this research is to discover whether materials for laser-hardened optics can be produced by ion-implantation of such inexpensive and plentiful semiconductors as Si and Ge.

Previous work has shown that devices which selectively filter 10.6- $\mu\text{m}$  light relative to 3.8- $\mu\text{m}$  light can be produced by implanting Si wafers with P<sup>+</sup> ions, whose energy and fluence have been chosen to optimize the depth and carrier density of the buried, optically-active P layer. Theoretical models suggest that the transmission selectivity of such devices may improve as their temperature rises, due to the thermal generation of charge carriers in the P layer. If this were indeed to occur, it might form the operational basis for a new, fast-acting optical "switch" that could quickly "turn off" transmission in the 10.6- $\mu\text{m}$  range after being heated by incident light in that wavelength range.

The present work was performed to study the temperature dependence of the IR transmission of a prototype device, consisting of a single-crystal Si wafer that had been implanted with  $1 \times 10^{16} \text{ P}^+/\text{cm}^2$ . Steady-state IR transmission measurements were made at wavelengths between 2.5  $\mu\text{m}$  and 40  $\mu\text{m}$ , and at temperatures between 20°C and 500°C. These measurements showed that although the transmission at all wavelengths decreased as the filter temperature was increased, the selectivity did improve at the elevated temperatures.

These steady-state measurements prompted studies of the transient response of such filters, in which pulsed CO<sub>2</sub> lasers were used to simultaneously illuminate and heat the filters, and fast photodiodes were used to measure the transmission of the 10.6- $\mu\text{m}$  light. The results indicated that these ion-implanted filters do indeed act like optical switches as their temperature is rapidly raised. Switch-off times of less than 20  $\mu\text{s}$  have been observed for CO<sub>2</sub> laser power densities of 1 MW/cm<sup>2</sup>, with greatly reduced switching behavior at 200 kW/cm<sup>2</sup>. Questions remain concerning the long-term consistency of the behavior and the possible effects of local melting and recrystallization of the Si.

Planned future work in this area includes further experimental studies using the pulsed-laser technique and refined model calculations to determine optimum filter materials, geometry, and implantation parameters.

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#### OXIDATION OF ION-IMPLANTED TITANIUM ALLOYS

Researcher: Assistant Professor Francis D. Correll

Sponsor: Naval Research Laboratory

This work is part of a larger study of the effects of ion implantation on the oxidation of pure Ti and of Ti aircraft alloys. The purpose of this project was to determine how implantation of Pt and Ba ions into the near-surface region of Ti6242 alloy affects its oxidation, and to correlate this information with independent measurements of the fatigue lifetimes of implanted and unimplanted samples.

Rutherford backscattering (RBS) analysis is the principal technique by which this oxidation has been studied. Using this technique, the thickness and composition of oxide films, as well as the depth distributions of the implanted ions, can be measured. The effect of ion implantation on the formation of oxide films or on the diffusion of oxygen or metal ions can be determined from these measurements.

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PHYSICS DEPARTMENT

RBS analyses were performed on Ti6242 rods that had been implanted with either Pt ions (energy = 143 keV; fluence =  $1 \times 10^{16}$  Pt/cm<sup>2</sup>) or Ba ions (125 keV;  $2 \times 10^{16}$  Ba/cm<sup>2</sup>) and oxidized in air at 850°F. These measurements indicated that such implantation does not inhibit oxidation of the Ti6242 alloy. On the contrary, the implanted portions of the rods exhibited thicker oxide films than did the unimplanted portions.

Prior to the RBS measurements, standard mechanical tests had shown that such implantation does increase the fatigue lifetime of these rods. The RBS results suggest that this improved lifetime may be due to the enhanced formation of stable stoichiometric oxide layers in the implanted rods, which may block the diffusion of oxygen into the bulk alloy. Such in-diffusion is known to reduce the fatigue lifetime of Ti alloys.

Planned future work includes a systematic study of the oxidation of pure Ti and of Ti6242 alloy, using both RBS and nuclear reaction analysis. The energy and fluence of the implanted ions, as well as the temperature, duration, and chemical environment of the oxidation, will be varied in a systematic way to yield maximum information on the role of the implanted ions in the oxidation process.

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**TRAPPED IONS IN SPACE (TRIS)**

Researchers: Sigma Pi Sigma ( $\Sigma\Pi\Sigma$ ) Physics Honor Society

Advisers: Assistant Professor Francis D. Correll and Lieutenant Commander Jeffery M. Perin, USN

Sponsor: Naval Research Laboratory

This project, which began in early 1981 and will continue through 1985, involves the design, construction, and deployment of a space-shuttle cosmic ray experiment. The project is managed by the  $\Sigma\Pi\Sigma$  Physics Honor Society in collaboration with the Laboratory for Cosmic Ray Physics at NRL. It benefits from the efforts of many midshipmen throughout the Brigade, as well as from the generous advice and support of many faculty members.

**SPONSORED RESEARCH****PHYSICS DEPARTMENT**

The goal of the experiment is to determine the composition, fluence, and energy spectra of low-energy heavy ions ( $Z \leq 6$ ,  $10 \text{ MeV/amu} \leq E \leq 50 \text{ MeV/amu}$ ) that are present at altitudes of 400-600 km above the earth. This information will help to reveal the origin of these particles, which is a question of fundamental interest in cosmic ray physics. It will also help in efforts to predict the effects of radiation on men and electronic equipment placed in orbit for extended periods of time, which is an important concern in the design of satellites and spacecraft.

Most of the effort this year has centered on developing plans for the basic apparatus. This apparatus is similar in concept to a simple box camera, and uses thin sheets of transparent plastic to record tracks made by the ions encountered during the spaceflight.

Progress has been made on the overall design of the camera, and a prototype has been constructed. Tests have been made using this prototype to determine the optimum configuration of the plastic track detectors, and a computer-assisted mechanical vibration analysis has been begun, using the GIFTS software package supported by the Naval Academy Time Sharing (NATS). A study of the electrical power required for moving the plastic film by computer-controlled motors and for heating the film to maintain its flexibility in space has been performed. A computer-aided thermal analysis of the payload has been begun, using a program obtained from NRL and implemented on NATS. Studies of the anticipated cosmic-ray background, based on models developed at NRL and elsewhere, have continued.

The design of the mechanical apparatus should be completed by December, 1982, when construction is scheduled to begin. At that time, development of the hardware and software for the on-board control computer will also begin.

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**AN EXPERIMENTAL AND THEORETICAL STUDY OF UNDERWATER TONE GENERATION BY FLOW OVER A SLOT: PHASE I**

Researcher: Professor Samuel A. Elder

Sponsor: Naval Sea Systems Command, Administered by the David W. Taylor Naval Ship Research & Development Center

The prevention of vibration and acoustic radiation generated by flow over slots or cavities in hulls is a recurrent problem in ship performance. Under previous contract support,

SPONSORED RESEARCH

PHYSICS DEPARTMENT

a theoretical model of slot-related tone generation was proposed, rooted in feedback amplifier analogy. This model is being tested and improved in the present series of underwater cavity tone experiments in the USNA High Speed Tow Tank Facility. The present apparatus consists of a towed-model configuration which is roughly equivalent to a flat plate with a small angle of attack. A rectangular slot along the side of the plate acts as the mouth of a free-flooding internal cavity. Movable and fixed hot film and hydrophone probes are used to map out the fluid dynamic disturbance created by the slot. During the year a breakthrough was made in the theory of sheartone oscillation with the development of a method of integrating the edge force from the frictionless equation of motion. This makes it possible to replace the empirical force presently used in the root-locus analysis and is expected to give better agreement with experiment, especially at higher sheartone modes. The new force-law has also led to a better understanding of Kutta Conditions at the upstream edge. A proposal to extend the present contract ("phase II") until September 1983 has been submitted.

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**DYNAMICAL PLANETARY MAGNETOSPHERIC FIELD MODELING**

Researcher: Assistant Professor Irene M. Engle

Sponsor: Naval Academy Research Council

A self-consistent magnetospheric field model for the "semi-inflated" state of the Jovian magnetosphere experienced by the Voyager flybys is almost completed. After fitting expansion parameters for the interior field to a model analogous to that used for the Engle-Beard fully-inflated magnetospheric field-model characteristic of the Pioneer flybys of Jupiter, an investigation of relationships between the parameters of the two models representing the two very different physical conditions will be made.

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## DEFECT PROPERTIES OF FLUORIDE CRYSTALS AND RELATED MATERIALS

Researchers: Associate Professor John J. Fontanella and  
Assistant Professor Mary C. Wintersgill

Sponsor: North Atlantic Treaty Organization

This project represents a collaborative effort between USNA and Dr. Chadwick of the University of Kent at Canterbury, England. The projects involved are as follows:

(1) The combined expertise of the two laboratories have been used to complete the studies of the rare-earth-doped lead fluoride systems. AC conductivities of the crystals have been measured and analyzed for the basic-defect parameters at Dr. Chadwick's laboratory. Dielectric relaxation measurements as a function of temperature and pressure were made at the laboratory at the U. S. Naval Academy.

(2) The techniques available for the study of defective systems has been increased in both laboratories. At Annapolis the temperature and pressure range of the dielectric apparatus has been enlarged and computer simulations capable of determining defect parameters have been developed. This latter development is a considerable achievement and will be of invaluable help in guiding the interpretation of the experimental results. At Kent, the crystal growth has been improved, particularly for heavily doped systems. Neutron scattering experiments are now possible. Plans are that Extended X-ray Absorption Fine Structure (EXAFS) work will begin in the next year. All these developments greatly increase our joint flexibility in the study of defective ionic crystals and these techniques have been used, where appropriate in this project.

(3) Results already obtained in this project include:

a. The determination of the type of impurity-defect complexes in rare-earth-doped lead fluoride.

b. The determination of activation energies for reorientation of the complexes in these materials.

c. The determination of activation volumes of reorientation of complexes in these materials.

d. The estimation of free-defect migration volumes and Frenkel-defect formation volume in lead fluoride.

e. The identification of the nature of impurity-defect complexes in doped lanthanum fluoride.

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**ACTIVATION VOLUMES AND ELECTRICAL RELAXATION IN ION CONDUCTING POLYMERS**

**Researchers:** Associate Professor John J. Fontanella and Assistant Professor Mary C. Wintersgill

**Sponsor:** Office of Naval Research

The primary objective of the work proposed is to measure the effect of pressure on the conductivity of ion-conducting polymers. These measurements will allow the determination of the activation volume of the ion motion observed as well as its thermal-expansion coefficient and compressibility which will be critical for determining the mechanism for ion motion.

Secondly, electrical relaxation measurements will be performed at zero pressure. In addition to the use of this technique in materials characterization, it will be of interest to search for relaxations which will yield further information on the transport mechanism and which will elucidate the defect structure of the materials, i.e., distinguish pairing or clustering of ions, etc. In addition, a search will be made for tunnelling phenomena such as have been seen in other ionic conductors.

Finally, some attention will be given to applying a recently developed computer program for studying defects and transport in ionic crystals to the problem of ion conducting polymers.

Initially, materials will be obtained from D. F. Shriver at Northwestern University. They will include materials such as complexes of poly(ethylene oxide) with various alkali salts which have been studied by other techniques. New polymer hosts and heavy-metal polymer electrolytes will be studied as they become available.

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**EXPERIMENTS ON THE SCATTERING OF SOUND BY TURBULENCE**

**Researcher:** Assistant Professor Murray S. Korman

**Sponsor:** Naval Research Laboratory

The energy of a propagating sound wave is physically coupled to other forms of energy that may exist in the fluid media. Fluid energy in the ocean can exist in many different forms; however, their detailed physical description is usually very complex. Turbulence is just one form of fluid energy in

the ocean. This complicated flow consists of both velocity and thermal fluctuations that represent a broad frequency distribution of energy. Another type of energy is background ocean-noise. This acoustical form of motion shares a common link with turbulent phenomenon in that each represents a statistical process.

A variety of underwater sound experiments will be performed in the large pool facility of the Physical Acoustics Branch at NRL. These experiments will investigate the scattering and harmonic redistribution of acoustic energy from the nonlinear interaction (coupling) of one or several sound beams with (1) a confined turbulent region of flow and (2) with a background of acoustic noise.

The experimental results will be compared with theoretical predictions. It is possible to describe characteristics of the turbulence and the noise from the intensity of the scattered sound.

These experiments parallel and extend existing work that is already going on at NRL in the area of nonlinear acoustics, scattering and diffraction theory, the investigation of thermal-acoustic phenomenon and the study of acoustical-optic interactions.

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#### SPECTROSCOPY OF WELDING ARC

Researchers: Associate Professor Bruce H. Morgan and  
Professor Ralph A. Goodwin

Sponsor: David W. Taylor Naval Ship Research and Development  
Center, Annapolis Laboratory

This continued the project begun in 1980, to carry out a spectral analysis of the light output from an Argon-shielded electric welding-arc on titanium, using photographic techniques, in order to determine the arc temperature. Many lines of Argon were identified and labeled on a master film last year. This year, the same was done for other lines, most of them titanium. To avoid uncertainties arising from spectral variation of film sensitivity, titanium lines within a small wavelength interval were selected for intensity studies. The output of the project consisted of opacity vs. wavelength data from scans over each of the selected lines, obtained from chart recordings made of densitometer output while scanning, along with a report describing and explaining the procedures used in the experiment including film calibration for relative incident intensity vs. opacity. This data was taken from each of several spectrograms

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covering a range of values of arc gap, arc current, and velocity of the titanium plate, which was on a motorized turntable.

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**PARTICLE SENSING**

**Researcher:** Associate Professor David A. Nordling

**Sponsor:** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The project is directed toward designing shipboard-wear particle monitoring and shipboard-pollution monitoring equipment using ultrasonic as the mode of detection.

The project is in the early developmental stage. A circulating test loop has been constructed and experiments investigating controlled amounts of particulates in water, in oil, and oil in water have been conducted. It is anticipated that information concerning size, shape, and size distribution in an on-line piping system can be obtained. This could lead to early warning of trouble in lubricating and hydraulic systems. The same technique has application to pollution monitoring.

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**LASER DAMAGE EFFECTS**

**Researcher:** Professor Charles W. Rector

**Sponsor:** Naval Research Laboratory

Bibliography was prepared (three parts: open literature, unclassified technical reports, classified technical reports) on the subject of laser effects. The current objective is to incorporate bibliographic information in a computer data base and to prepare access routines for input, keyword search, and output from data base.

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SPONSORED RESEARCH

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**BIAXIAL MAGNETOELASTICITY IN STEELS**

**Researcher:** Professor Carl S. Schneider

**Sponsor:** David W. Taylor Naval Ship Research and Development Center, Annapolis Laboratory

The effects of stress on magnetization, magnetic reluctance, and domain-wall distributions has been studied from observations of magnetization changes with field and stress. Three samples were used to confirm biaxial effects: a long rod for coaxial stress, a hollow cylinder for transverse stress, and a hollow toroid for biaxial stress. Reluctance is found to increase linearly with a predictable slope due to coaxial compression or transverse tension and to reach a limiting minimum under reverse stress. Complex stress-field processes may now be predicted well beyond the Rayleigh region.

\*\*\*\*\*

**HARMONIC GENERATION IN THE EXTREME ULTRAVIOLET**

**Researcher:** Assistant Professor Lawrence L. Tankersley

**Sponsor:** Naval Research Laboratory

The XeCl laser system was upgraded by adding a pulse slicer. The addition allows the system to produce subnanosecond pulses with peak powers in excess of 40 MW. A parallel laser system using ArF is being developed. These systems have allowed a study of the time-dependent saturation of laser amplifiers, the saturation of non-linear medium, and the harmonic conversion process in media with positive dispersion. A numerical study of the harmonic conversion process is underway to provide a guide to experimental efforts.

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**CAPACITIVE PRESSURE TRANSDUCERS AND PRESSURE FIXED POINTS**

**Researcher:** Midshipman 1/C Frank P. Pursel

**Advisers:** Associate Professor John J. Fontanella and Assistant Professor Mary C. Wintersgill

**Sponsor:** Trident Scholar Program

The measurement of high pressures (above 4000 atmospheres) is currently very complicated and not well-defined. One alternative is a pressure transducer utilizing the change of

capacitance of a solid dielectric with pressure. In the past the usefulness of such transducers has been limited since the capacitance also usually changes with temperature.

The researcher attempted to develop a new material for use in such a gauge. His work centered on studies of lead fluoride ( $PbF_2$ ) since that material has several unusual and desirable properties with respect to such gauges. In the course of the work, the solid-solid phase transition was also investigated for possible use as a pressure fixed point. That work led to the discovery that  $PbF_2$  transforms at pressures far below those previously reported. Also, it was found possible to mathematically model the rate at which the phase transformation took place. This rate was found to be related to the pressure at which the transformation occurred. It was also discovered that the phase transformation of lead fluoride is a two-stage process wherein the first stage may be inhibited by the addition of certain dopants to the crystal. These same dopants were also found capable of significantly altering the rate at which the transformation occurred and, hence, also the pressure at which the transformation could be observed. Consequently, a great deal of new, basic knowledge was obtained for lead fluoride and showed that the construction of such a gauge is indeed feasible.

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A DOPPLER ELIMINATION SYSTEM FOR MERCHANT SOURCE LEVEL ACQUISITION

Researcher: Midshipman 2/C Thomas H. Bond, Jr.

Adviser: Research Professor Robert L. Jennette

Because of a stationary receiver and moving source, the received merchant acoustic data will be tainted with a doppler shift that will inhibit proper source level acquisition. There are many ways to tackle this problem, but the actual method will follow the dictates of available hardware.

After searching for available equipment, one method presented itself as best suited for this purpose. Because of low accelerations in relative velocity between the merchant and the hydrophone receiver, continuous doppler removal is unnecessary. The method of doing this is to break up the recorded acoustic data (time history) of the merchant (which can be up to 200 seconds of continuous data) into two-second segments, digitally apply the average frequency shift that the signal has over that two-second segment and thus produce a corrected acoustic signal without doppler. Each frequency shift will be computed and applied to the respective two second segment of time history. Using the digital computer in the Hydromechanics Lab of USNA, these corrections will be made and then each segment will be replaced in order, producing a corrected "true" acoustic signal. The advantage of using the Hydromechanics Lab's digital computer facilities is that it has a large memory capacity and can store and correct all the data and retain it on one storage device.

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THE FRESNEL SPIRAL CONCENTRATOR

Researcher: Midshipman 1/C A. H. Davis, Jr.

Adviser: Professor Billie J. Graham

A new design in concentrator-type solar-energy collectors is the Fresnel spiral concentrator. The concentrator design is based on the Fresnel diffraction principle and is made by increasing the coil of a spiral cut from a rigid, flat sheet. The flat surface is covered with a reflecting material and then mounted on a rigid planar frame in such a fashion as to achieve a desired focusing strength. The focal point of the collector can be adjusted by adjusting the tightness of the coil of the spiral. Even a negative focal length can be achieved, depending on how the spiral is coiled. Construction of such a collector

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is relatively simple and inexpensive. A Fresnel spiral concentrator about four feet in diameter and with a focal length of 28-inches was built and tested. The collector had a concentration ratio of about 23, and it produces a spot at the focal point of about 15 in<sup>2</sup>.

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**MERCHANT SHIP ACOUSTIC SOURCE LEVELS (DATA PROCESSING)**

**Researcher:** Midshipman 2/C Daniel N. Dixon

**Adviser:** Research Professor Robert L. Jennette

The project included such important concepts as sampling frequency, aliasing, fast-fourier transform and probability theory. Signal-processing fundamentals were applied to devise a tentative post-experiment data-analysis flow chart. This flow chart incorporated the parameters of the equipment to be used as well as the custom features desired in the processing. An HP-4051 Tektronic computer was programmed with the software necessary to gather the data. In order to make the computer mobile, these programs were recorded on a magnetic tape in proper sequence to ensure efficient "at-sea" data-gathering. To date, the programming, recording, and a majority of the debugging has been completed; so, as soon as the ordered hardware comes in, the actual "at-sea" data gathering procedure may commence.

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**MERCHANT SHIP ACOUSTIC SOURCE LEVELS (TOW DESIGN)**

**Researcher:** Midshipman 1/C John W. Judge

**Adviser:** Research Professor Robert L. Jennette

Coordination and organization of the Midshipmen Research Team was accomplished. An underwater towing system for a calibrated acoustic transducer was designed and tested in the U. S. Naval Academy 350' tow tank. A written report covering the project status and accomplishments was prepared and a brief given to the Superintendent of the U. S. Naval Academy, detailing the project's purpose, scope, and intentions.

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**RESEARCH COURSE PROJECTS**

**PHYSICS DEPARTMENT**

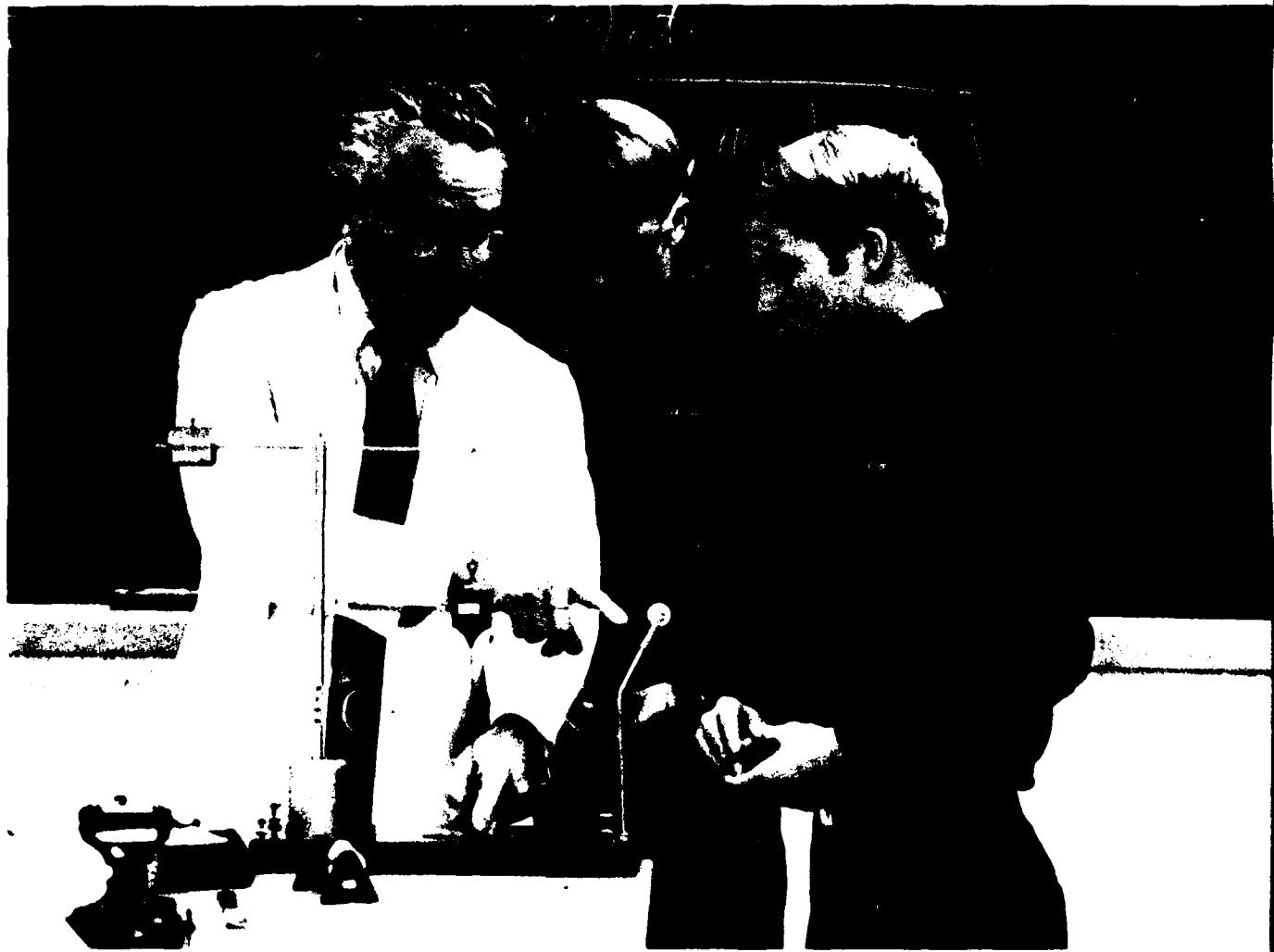
**MERCHANT SHIP ACOUSTIC SOURCE LEVELS (NAVIGATION)**

**Researcher:** Midshipman 2/C William J. Schulz

**Adviser:** Visiting Professor P. R. Street

Computer programs were designed to reconstruct the true track of the merchant from three or more lines-of-position and one or more fixes. Another computer program was designed to measure the cross-track error and along-track position of the research vessel trying to make good the merchant ship's track.

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PUBLICATIONS

PHYSICS DEPARTMENT

BRILL, Donald W., Associate Professor, co-author, "The Response Surface in Elastic Wave Scattering," Journal of Applied Physics, 52 (May 1981), 3205-3214.

The normal-mode amplitudes for the scattering of (compressional and shear-type) elastic waves returned by a fluid-filled spherical cavity in a solid in the absence and presence of mode conversion were studied and their unitarity properties examined. The moduli of the resonance portions of these dimensional graph, where the two independent variables are (non-dimensional) frequency and mode order. Various distinctive features of the response surface are displayed and explained for different combinations of incident and scattered waves. The informative features, graphically displayed at a glance in the plots of the response function, are useful in the interpretation of the scattering process taking place around fluid-filled cavities in solids, and in the identification of the material composition of the cavity contents, if the fillers were not known a priori.

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CORRELL, Francis D., Assistant Professor, co-author, "The  $^4\text{He}(\vec{d}, p\alpha)n$  Reaction at 12 and 17 MeV," Bulletin of the American Physical Society, 27 (1982), 560.

The  $^4\text{He}(\vec{d}, p\alpha)n$  reaction with 12- and 17-MeV  $\vec{d}$  beams has been studied. A 2.5-cm-diameter gas cell with a 0.5-mil Kapton window operated at 800 Torr, and two detector telescopes in coincidence with standard NIM electronics and an on-line computer data acquisition and analysis system were used. The breakup reaction cross-section and the polarization observables  $A_y$ ,  $A_{yy}$ , and  $A_{xx}$ , was measured. The energy resolution was 200-250 keV and the angular resolution was  $1.5^\circ$ . Measurements were obtained for those parts of phase space which favored  $n-\alpha$  FSI,  $p-\alpha$  QFS interactions and, in one case, included the collinearity condition. For the 12-MeV data, predictions from a three-body model with which the data are in reasonably good agreement have been made.

\*\*\*\*\*

CORRELL, Francis D., Assistant Professor, co-author, "Optical Switching Properties of Amorphous Silicon under High-Power Laser Irradiation," Naval Research Laboratory Letter Report to sponsors of the Navy Laser-Hardened Materials Program, December 1981.

Experiments have been performed to determine whether optical switching behavior can be observed in amorphous layers produced by the implantation of crystalline silicon (Si) wafers with energetic phosphorous (P) ions. Such switching might be produced by the thermal generation of charge-carriers in the optically-active P<sup>+</sup> layer and the subsequent absorption of incident light by the resulting electron plasma. Single-crystal Si wafers of 10Ω-cm resistivity were implanted with P ions to a fluence of  $1 \times 10^{16}$  P/cm<sup>2</sup>. Because of the unavoidable coexistence of 400-keV p<sup>++</sup> ions with 187.5-keV P<sup>+</sup> ions in the nominal 400-keV beam, the depth profile of the implanted ions was nearly equally distributed about two depths: 4000 Å and 7000 Å. The amorphous layer produced by this implantation extended to nearly 8000 Å. The time-dependent transmission of these samples for 10.6-μm light was measured using a pulsed CO<sub>2</sub> laser to simultaneously heat and illuminate the sample, and a fast photodiode to detect the transmitted light. Optical switching was observed in some samples for incident power densities of 1 MW/cm<sup>2</sup>. For these samples, approximately 70% of the initially-transmitted light was blocked within 20 μs of the incident pulse. Questions remain concerning the consistency of this behavior and the possible effects of local melting and recrystallization of the amorphous layer.

\*\*\*\*\*

ELDER, Samuel A., Professor, co-author, "Mechanisms of Flow-Excited Cavity Tones at Low Mach Number," Journal of the Acoustical Society of America, 72 (1982), 532-549.

Cavity tone spectra have been investigated as a function of wind speed in a low noise wind tunnel, at Mach numbers below 0.2. The cavity, a cylindrical closed pipe with a rectangular slot for a mouth opening, was flush-mounted in the side of a flat plate, 30 inches downstream of the leading edge. Both laminar and (tripped) turbulent boundary layer effects were explored. Contributions to tone generation from turbulent boundary-layer fluctuations, acoustic background noise, sheartone feedback coupling are quantitatively sorted out on the basis of theoretical models. A theory of laminar pipetones, complementing an earlier model of turbulent pipetones, is used as a basis for explaining sheartone/pipetone interaction. An empirical correction curve is introduced to take into account the slowing of wave-speed in thick shear layers.

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PUBLICATIONS

PHYSICS DEPARTMENT

ELDER, Samuel A., Professor, author, "Aerodynamic Mechanisms in Jet-Edge-Resonator Oscillation," USNA Report E82-1, January 1982.

The existence of the simple source mechanism used in the currently accepted explanation of pipetone oscillation is justified by direct integration of the Lighthill tensor for a finite shear-layer oscillating at finite amplitude. By a similar integration, the transverse dipole at the downstream edge, postulated by Powell, is also deduced, as well as a longitudinal dipole believed to be responsible for exciting oscillation in shallow cavities at low Mach number. Each of the forces derived by this method are directly proportional to shear-layer width, and cannot therefore, be derived from theories using the vortex sheet approximation. Examination of the two Kutta conditions of Orsag and Crow suggests that the "rectified" Kutta condition applies to shear-layer interaction with a single-plane boundary, while the "full" Kutta condition applies (approximately) to jet-nozzle situations over the frequency range of jet instability.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "Activation Volume for Ion Motion in PEO·NaSCN," Bulletin of the American Physical Society, 27 (1982), 167.

Complex impedance measurements have been performed at zero pressure from 5.5-380K and at pressures up to 0.2 GPa at 320K for various samples of PEO·NaSCN. Four different regions are observed in the imaginary part of the dielectric constant. Above 330K, electrode effects are dominant. From 310-330K the effects of electrodes are minimal, and the samples exhibit conductivity depending upon temperature only. Below 280K, the  $\beta$  and  $\lambda$  relaxations are observed though the  $\beta$  relaxation is super-imposed on the DC conductivity. In agreement with the configurational entropy model, the effect of increasing pressure is to decrease the ionic conductivity. Further, the data yield on activation volume of about 24 cm<sup>3</sup>/mol which is in good agreement with the predictions of a dynamical diffusion model.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "Clustering in Rare-Earth-Doped Alkaline Earth Fluorides," Journal of Physics C: Solid State Physics, 14 (1981), 3557-3574.

Audio-frequency capacitance and conductance measurements have been carried out for calcium fluoride doped with 1.0 mol% of thirteen rare earths, and 10 and 20 mol% of erbium and lanthanum; strontium fluoride doped with 0.1 and 1.0 mol% of twelve rare earths, yttrium and lanthanum; and barium fluoride doped with 0.1 mol% of twelve rare earths, yttrium and lanthanum.

For the moderately-doped calcium fluoride samples, it is found that the low-temperature ( $R_m$ ) relaxation dominates the spectrum for small rare earths.  $R_m$  is associated with either a higher-order complex trimer) or a superstructure. For large rare earths, the dimer-associated  $R_{iv}$  ('gettered' 2:2:2) relaxation dominates the spectrum. In addition, two new relaxations are found for intermediate-size rare earths. The activation energies for the two new relaxations depend strongly upon the size of the rare earth, suggesting that the structures for those clusters are similar to that for the  $R_{iv}$  dimer. The heavily doped erbium sample exhibits  $R_m$  only, correlating that relaxation with the D(2a) site of Wright and co-workers.

The primary result for strontium fluoride is the observation of a new relaxation in the heavily-doped samples with an activation energy which depends strongly upon the size of the rare earth and thus is attributed to  $R_{iv}$  dimers. Coincidentally, the activation energy for that relaxation in lanthanum-doped strontium fluoride is approximately equal to that for NNN dipoles in strontium fluoride doped with small rare earths. Consequently, this relaxation has been misidentified by other workers in their studies of lanthanum-doped strontium fluoride.

Other results may be summarized as follows. The  $R_{iv}$  dimer becomes less stable as the host size increases but also as the rare earth size decreases. For smaller rare earth dopants,  $R_m$  is more stable in the smaller hosts and appears at lower concentrations in smaller hosts. Correspondingly, the complexity of the dielectric spectrum increases for smaller hosts and smaller rare earth dopants. However,  $R_m$  is observed for larger rare earths in the larger host lattices. Also, the maximum in dielectrically observable dipoles as a function of total concentration occurs at higher concentrations for larger host lattices. These results are compared with those of selective laser excitation studies.

Finally, the evidence for a relationship between the complexes responsible for  $R_{ii}$  and  $R_m$  is presented.

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PUBLICATIONS

PHYSICS DEPARTMENT

**FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL,  
Assistant Professor, "Computer Calculation of the Effect of  
Pressure on Motional Enthalpies in the Alkaline Earth  
Fluorides," Bulletin of the American Physical Society, 27  
(1982), 195.**

A recently-developed computer model for studying defects in ionic materials is used to calculate the reorientation enthalpies and their variation with lattice constant for various dipolar defects in the alkaline earth fluorides. Calculations are performed for the jumps of interstitials around several different rare earths. The calculated enthalpies are larger than the experimental values but are still significantly lower than the values for the motion of free interstitials. In addition, it is found that the reorientation enthalpy varies little with the size of the rare earth which is in good agreement with experiment. In addition, the calculated variation of the activation enthalpy with pressure is in excellent agreement with experiment.

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**FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL,  
Assistant Professor, "Defect Structure of Rare Earth Doped  
Cubic Lead Fluoride," Bulletin of the American Physical  
Society 27 (1982), 194.**

Audio frequency complex impedance measurements are performed over the temperature range 5.5-400K on lead fluoride doped with eleven rare earths, yttrium, and lanthanum. It is found that the complexity of the relaxation spectrum increases as the size of the trivalent ion decreases. Specifically, for the largest rare earths, only one relaxation is found, presumably due to reorientation of a NN interstitial charge compensator between equivalent sites. However, that relaxation is different from the analogous peak in the alkaline earth fluorides in that the reorientation enthalpy depends strongly upon ion size. For the smallest rare earths, however, at least nine relaxations are found. The concentration studies indicate that there are multiple relaxations per complex and that both simple sites and clusters exist.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "Point Defect Activation Volumes in the Alkaline-Earth Fluorides," Journal of Physics C: Solid State Physics, 14 (1981), 2451-2464.

The effect of pressure on complex impedance has been measured for sodium-, potassium-, rubidium-, and praseodymium-doped strontium fluoride and potassium-, rubidium-, and erbium-doped barium fluoride in the region of each principal relaxation. The activation volume is determined for each relaxation and is compared with a theoretical prediction. From the results, it is concluded that the dominant mode responsible for vacancy motion can be modelled by the zone-centre Raman mode and that the principal mode involved in interstitial motion can be modelled by the zone-centre transverse optic mode. In addition, an estimate of the activation volume for the motion of 'free' defects is made. Finally, it is found that, in general, the thermal expansion coefficient for the migration volume of a defect is negative. Also, the compressibility of the migration volume for vacancies is found to be larger than for interstitials.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "The Effect of Impurities on the Cubic-Orthorhombic Phase Transition in Lead Fluoride," Bulletin of the American Physical Society 27 (1982), 326.

The cubic-orthorhombic phase transition at 330K has been studied for lead fluoride doped with various amounts of divalent (strontium) and trivalent (rare earths) impurities. The transition has been detected using complex impedance measurements. It is found that trivalent ions have a large effect on the position of the phase transition. For example, 3.0 mol-% of erbium shifts the transition pressure from 0.3 GPa to at least 0.5 GPa. The effect is correlated with the defect complexes which are observed using low temperature relaxation measurements. For the strontium-doped materials, 2.5 and 5 mol-% increase the transition from 0.3 to 0.37 and 0.5 GPa respectively. In both cases, the interpretation is that the impurities reduce the softness of the mode thought to be responsible for the transition. The kinetics of the transition are also discussed.

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FONTANELLA, John J., Associate Professor and Mary C. WINTERSGILL,  
Assistant Professor, "The Relation Between Bound and Free  
Ion Motion in Some Fluorides," Solid State Ionics 5 (1981),  
585-588.

Audio frequency complex impedance measurements for sodium and lanthanum-doped lead fluoride and calcium-doped lanthanum trifluoride are presented. In addition, it is shown that useful information concerning ion transport can be obtained by studying the motion of bound charge. For example, the motion of a bound vacancy simulates that of a free vacancy when the size of the aliovalent substitutional is close to that of the host cation. Also, for the alkaline earth fluorides, the dominant mode involved in vacancy (interstitial) motion can be modelled by the zone center Raman (transverse optic) mode. Next, it is shown how an estimate of the activation volume for motion of free interstitials can be obtained from those of bound interstitials. Finally, theories of ion motion based solely on bulk properties are discussed.

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KORMAN, Murray S., Assistant Professor, co-author, "Scattering From Crossed Ultrasonic Beams in the Presence of Turbulence," Journal of the Acoustical Society of America (Supplement 1) 71 (Spring 1982), 530.

Experimental results on the mutual scattering from two perpendicularly-directed, continuous ultrasonic beams interacting in the presence of turbulence in water have been shown to produce a sum-frequency component that radiates outside the interaction region. Measurements of spectral broadening and Doppler shift have been reported by the authors. An investigation of the scattering mechanisms suggests that scattering to lowest order is from the cubic quadrupole source term in the wave equation (the Reynolds stress tensor  $\rho u_i u_j$ ). This mechanism allows an excess acoustic density  $\rho = \rho_1 + \rho_2$  to interact nonlinearly with acoustic particle velocities  $u_i^L + u_i^L$  and turbulent velocity fluctuations  $u_i^T$ .

The theoretical results for the temporal spectrum density of the scattered sum frequency are compared with single beam scattering. The Doppler shifts of the two scattered primary waves, when added together, equal the Doppler shift of the sum frequency for each scattering angle. The prediction for the angular dependence of the sum's broadening is  $\Delta f_s \sim \sin(\theta - 45^\circ)/2$ . These results are in good agreement with experiment.

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PUBLICATIONS

PHYSICS DEPARTMENT

TANKERSLEY, L. L., Assistant Professor, co-author, "Generation of Coherent Radiation at 61.6 nm, by Fifth Harmonic Conversion of Radiation from a XeCl Laser," Optics Communications, 39 (1 November 1981) 334-338.

Fifth harmonic conversion of radiation from a XeCl laser in Ar and Kr, generating radiation at 61.6 nm, is reported. Fifth-power-law variation of the generated energy with the pump energy is observed. The effects of continuum absorption are observed in the width of the phase matching peak in Ar.

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PRESENTATIONS

PHYSICS DEPARTMENT

BRILL, Donald W., Associate Professor, co-author, "Acoustic Spectroscopy," 102nd Meeting of the Acoustical Society of America, Miami, Florida, 30 November - 4 December 1982.

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ELDER, Samuel A., Professor, "Shear Flow Induced Tones," Classified Conference at David W. Taylor Naval Ship Research and Development Center, Carderock, Maryland, April 1982.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "Activation Volume for Ion Motion in PEO-NASCN," March Meeting of the American Physical Society, Dallas, Texas, 8-12 March 1982.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "The Effect of Impurities on the Cubic-Orthorhombic Phase Transition in Lead Fluoride," March Meeting of the American Physical Society, Dallas, Texas, 8-12 March 1982.

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FONTANELLA, John J., Associate Professor, and Mary C. WINTERSGILL, Assistant Professor, "Defects and Conduction Processes in Lanthanum Fluoride," Autumn Meeting, Dalton Division of the Royal Chemical Society, University of Leeds, England, 22-24 September 1981.

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FONTANELLA, John J., Associate Professor, Mary C. WINTERSGILL, Assistant Professor, Frank P. PURSEL, Midshipman 1/C, and Peter J. WELCHER, Assistant Professor, "Pressure Dependent Electrical Processes in Lanthanum Fluoride," 13th Washington Area High Pressure Colloquium, Naval Research Laboratory, Washington, D. C., 13 November 1981.

\*\*\*\*\*

FONTANELLA, John J., Associate Professor, Mary C. WINTERSGILL, Assistant Professor, and Peter J. WELCHER, Assistant Professor, "Dielectric Spectroscopy in Rare Earth Doped Lead Fluoride," Second European Conference on Solid State Chemistry, 'DeKoningshof' Veldhoven, The Netherlands, 7-9 June 1982.

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PRESENTATIONS

PHYSICS DEPARTMENT

JENNETTE, Robert L., Research Professor, co-author, "Narrow Band False Contact Analysis," TSC Report 23-229 Conference, Laurel, Maryland, 15 July 1981.

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SHELBY, Robert N., Professor, co-author, "Alpha Induced Switching Events in Josephson Tunnel Junctions," Bulletin APS Meeting, Dallas, Texas, March 1982.

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SMITHSON, John R., Professor, "Albert Michelson, America's First Nobel Laureate in Physics," National Meeting of the Society of Physics Students, Washington, D. C., 28 April 1982.

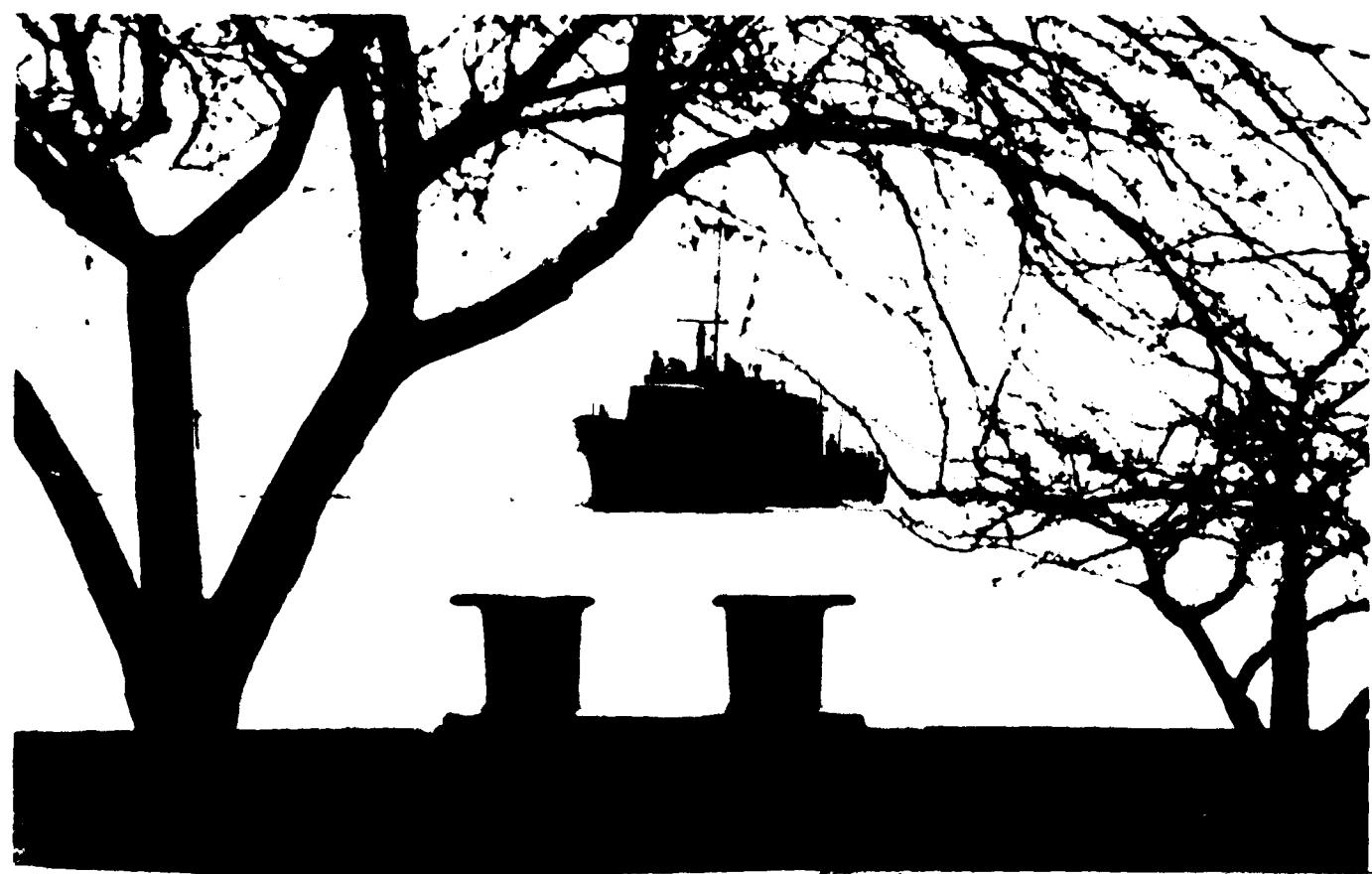
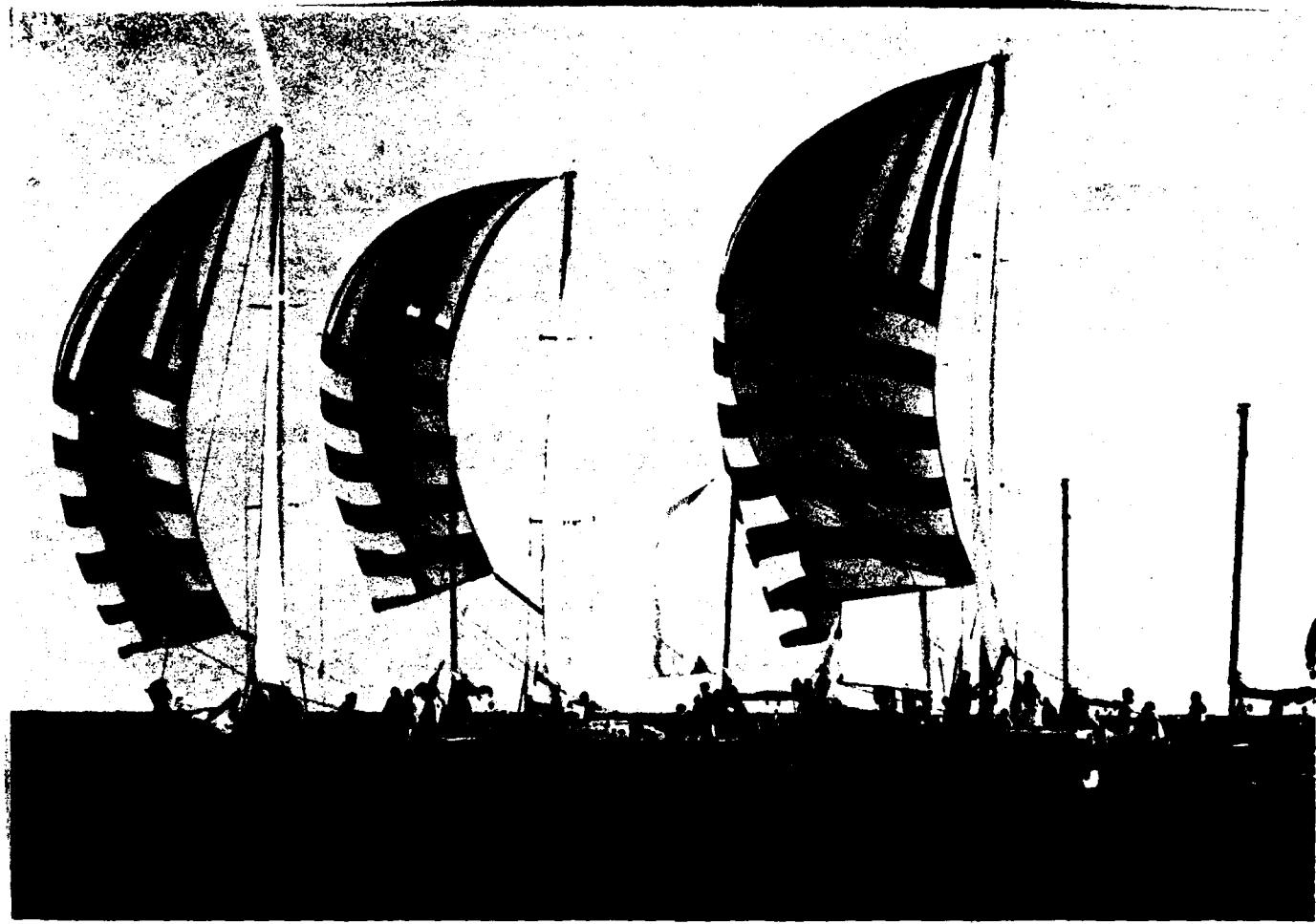
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WINTERSGILL, Mary C., Assistant Professor, Peter J. Welcher, Assistant Professor, and John J. FONTANELLA, Associate Professor, "Computer Calculation of the Effect of Pressure on Motional Enthalpies in the Alkaline Earth Fluorides," March Meeting of the American Physical Society, Dallas, Texas, 8-12 March 1982.

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WINTERSGILL, Mary C., Assistant Professor, and John J. FONTANELLA, Associate Professor, "Defect Structure of Rare Earth Doped Cubic Lead Fluoride," March Meeting of the American Physical Society, Dallas, Texas, 8-12 March 1982.

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DIVISION OF  
PROFESSIONAL DEVELOPMENT



## LEADERSHIP AND LAW DEPARTMENT

*Commander John M. McGrath, USN, Chairman*



Leadership and Law supports limited research that directly supports institutional objectives. Currently members of this Department are involved in research projects in the areas of integration of women, professional and career development, program validation, and sports psychology.

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SOME PSYCHOLOGICAL FACTORS RELEVANT TO SUCCESSFUL ATHLETIC PERFORMANCE

Researcher: Lieutenant Dennis A. Kelly, MSC, USN

Sponsor: Naval Academy Research Council

The overall objective of this research is to assess the influence of certain specified psychological variables on athletic and physical education performance in a number of diverse areas, the working model being one which emphasizes the interaction between person and situational factors.

The first stage of this research, which is nearly completed, has focused on constructing an instrument whereby the physical, mental, emotional, and interpersonal demands of different athletic activities could be identified. In an initial sample, 291 Third Class midshipmen were asked to select a specific sport with which they have had experience and to rate the sport along a number of dimensions. Following the analysis of these results, a revised instrument consisting of 50 items was administered to 553 Third, Second, and First Class midshipmen, with the same instructions. This second questionnaire was also readministered a month later to a sample of 138 of the above 553 midshipmen.

Factor analysis on the total sample, using the orthogonal method, yielded the following eight factors, which, in order, accounted for the most variance: Physical Exertion, Individual Control, Coordinated Speed, Interpersonal Support, Emotional Arousal, Cognitive Efficiency, External Attention, and Disinhibition. The individual items which clustered into each of these factors were identified and analyzed further for stability and discriminability. Forty-one of the 50 items were retained. Spearman Rho test-retest coefficients for this group of items ranged from .55 to .94, with a mean of .71. Spearman test-retest coefficients for the eight factors ranged from .76 to .91, with a mean of .85. The researcher has also categorized the total respondent group into 45 subgroups, based on the various athletic activities rated, and is using the above eight factors to construct standardized profiles of the requirements of each sport. The next stage in this research will be an attempt to relate these differing demand-profiles to person-variables and optimal-preparation strategies.

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DEVELOPMENTAL STRUCTURE AND ADULT SOCIALIZATION

Researcher: Associate Professor Patrick R. Harrison

This research uses cohort sequential designs to look at adult socialization in particular roles and settings. Two years worth of data on midshipmen across classes which measured perception of organizational climate, perceptions of power, and leadership and specific attitudes is being used for the core analysis. Performance, motivation, and values are all considered in defining specialization in this research program. This research is in its second year.

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EXPERIMENTAL SIMULATION OF BEHAVIORAL RESEARCH PROBLEMS

Researcher: Associate Professor Patrick R. Harrison

This project develops a large-scale interactive computer simulation of behavioral research problems that span the topic areas of the Military Psychology Course including motivation, perception, learning, memory, personality, and physiology. The students conduct experiments in simulation mode, developing research strategies and formulating meaningful results and conclusions. The simulator also provides a 'build' simulator which teaches staff members how to program their own simulations into the system. The project is in its third year.

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**AN ECOLOGICAL MODEL OF CAREER DEVELOPMENT**

**Researcher:** Associate Professor Patrick R. Harrison

Current models of career development can be described in terms of three generic classes: (1) psychological models that use the developing personality as the central construct in career development; (2) organizational models that describe career development in terms of the immediate interactions of individuals with particular structures within an organization; and (3) socio-logical models which focus on macro-variables that constrain and direct career development. The purpose of this paper is to develop a general systems framework which incorporates the elements of the three generic career-development models. The general systems model is presented as a hierarchically organized interactional system to account for the strong effects of physically and psychologically-distant environments on the individual's career development.

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HARRISON, Patrick R., Associate Professor, "Attitudes Towards Women at the United States Naval Academy," Technical Report, 1981.

In the Fall 1981, a questionnaire was administered to a random sample of male and female midshipmen in each of the four classes. The questionnaire measured attitudes towards women in society, women in the military, and women at the United States Naval Academy.

Comparisons with attitude data from the same questionnaire administered in 1977 showed no significant change in overall attitudes towards women in society, in the military or at the Naval Academy for male or female midshipmen. The data suggested that lack of role legitimacy and role confusion were the major factors conditioning these attitudes.

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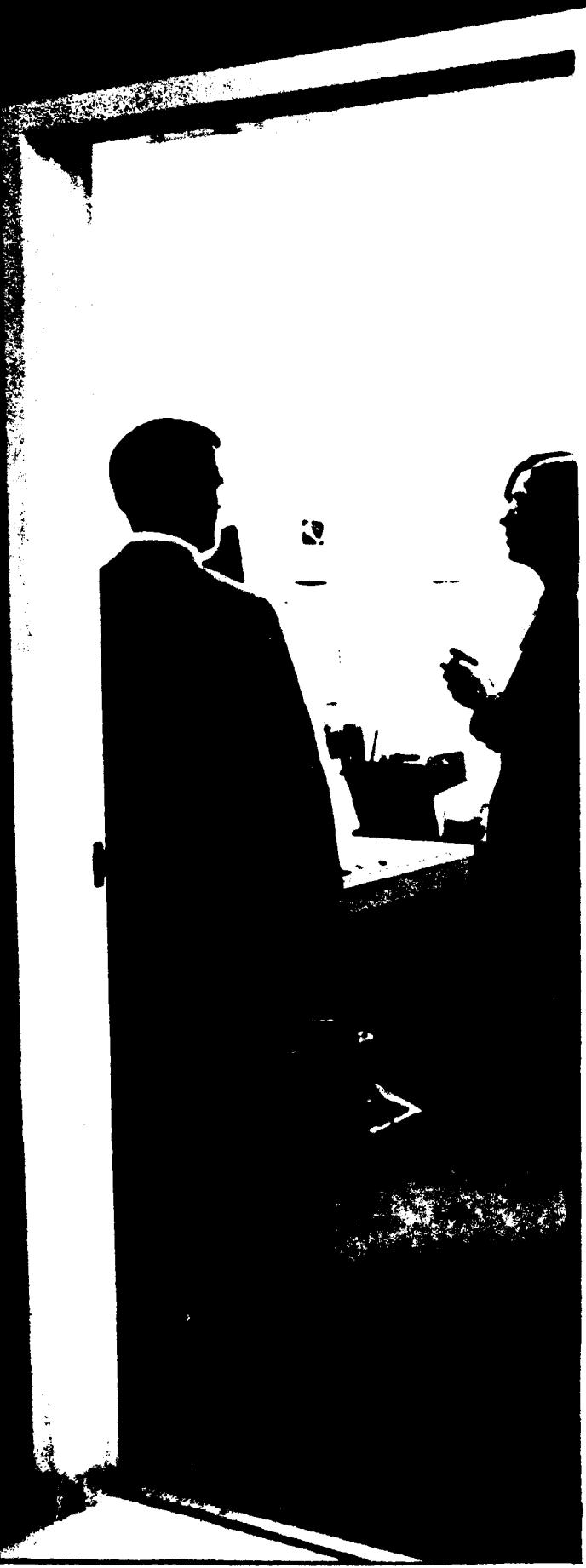
HARRISON, Patrick R., Associate Professor, "A Model for Organizing an Introductory Psychology Course," Fourth National Institute on the Teaching of Psychology to Undergraduates, Clearwater Beach, Florida, January 1982.

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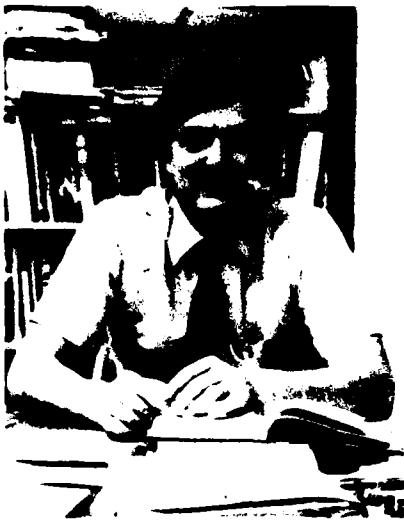
DIVISION OF  
U. S. AND INTERNATIONAL STUDIES

# ECONOMIC



## ECONOMICS DEPARTMENT

Associate Professor Roger D. Little, Chairman



For this brief report on research activities in the Economics Department, I would like to address a research initiative the Department has been fostering over the last two years rather than attempt a more comprehensive summary. The initiative to which I refer is an emphasis on applied research in areas of defense economics. Our goal is to encourage research on defense-related problems by our present faculty, by new faculty when they are hired, and by attracting a visiting professor each year who has expertise in defense economics. Four civilian members of the Department are engaged in this

type of research at the present time and others are exploring avenues through which their training can be brought to bear on defense problems. We envision these activities leading to the incorporation of relevant defense-related applications into many of our upper level courses. Because the integration of one's research and teaching adds a dynamic element often missing in many classrooms, the initiative we have undertaken promises to enhance the quality of our course offerings while at the same time creating an appropriate professional image for a service academy faculty.

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**ECONOMIC BARRIERS TO LATERAL ENTRY**

Researcher: Assistant Professor William R. Bowman

Sponsor: Office of Naval Research

Recruitment and retention of qualified manpower is the most urgent concern of the military forces. The research provides an information base that can be of immediate use in addressing that concern. Specifically, the study determines the extent to which military training yields long-term benefits to recruits in the form of higher post-service earnings. Such benefits, if they can be documented, can serve as an enhanced inducement to military enlistments, thereby improving both the rate and quality of volunteer recruits.

Prior studies of veteran earnings have been inconclusive on this important question, largely because of inadequate data bases. The uniqueness of this study lies in the data source used for analyses, namely the Social Security Administration's LEED file. The LEED file contains detailed employment and earnings histories for one percent of all persons in employment covered by social security legislation (including the military). As such, it permits one to track individual earnings and employment experiences before, during, and after military service. By tracking both veterans and non-veterans, the researchers will be able to assess the relative gains due to military service.

The study uses the relative earnings mobility framework developed by Dr. Bradley Schiller, the project director. The value of this framework is that it addresses distributional issues directly, without subjecting earnings data to general inflation or productivity distortions. The methodology also allows for distinctions between veterans of different age, race, and war-era groups.

Findings from this study should prove useful as a recruiting device in the All-Volunteer Force (AVF), especially since military pay, adjusted for inflation, has eroded each year since the inception of the AVF. Recruits can be assured that the monetary benefits to military service are not realized solely within the military establishment but may be realized in the civilian sector long after their military service.

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SOCIOECONOMIC CHARACTERISTICS OF THE ALL-VOLUNTEER FORCE:  
EVIDENCE FROM THE NATIONAL LONGITUDINAL SURVEY, 1979

Researchers: Associate Professors J. Eric Fredland and  
Roger D. Little

Sponsor: Office of Naval Research

This report contains six separate, although related, studies. Each study compares young male members of the all-volunteer force as of 1979, either with men of the same age cohort who are not serving, or with those too young to serve at the time of the survey. The studies are cross-sectional. They address the following areas: socioeconomic characteristics; attitudes and intentions to serve of 14 to 17-year-old males; vocational training; educational levels, aspirations, and expectations; job problems and characteristics; and job satisfaction.

Numerous policy inferences, particularly relating to recruitment and retention, can be drawn from the results of these studies. For example, reinstitution of post-service educational benefits is unlikely to attract higher quality personnel into the Armed Forces. Results show that large numbers of those with high educational aspirations and expectation already join the service. Post-service educational benefits probably would be widely used by those who join the service, but most of these individuals would have joined anyway. It appears doubtful that such benefits would induce large numbers of high quality people to volunteer who would not have done so without them.

Programs designed to make it easier and cheaper to pursue further education while on active duty may be useful in promoting retention. Educational aspirations among those in the military are particularly high. These people may stay in the service to satisfy these aspirations.

Improvement of manpower quality cannot come to any significant degree by recruiting "representative" quality manpower. If improved quality, as measured by education, training, health, etc. is necessary to the mission of the armed forces, it must come by procurement of above-average quality personnel.

The potential recruiting pool, defined to include those who have expressed some interest in serving, is neither small nor of particularly poor quality relative to the total age cohort. Efforts should be directed toward arresting the decline in interest as age and school grade increases, perhaps by establishing contact earlier.

Job satisfaction in the military is low compared to job satisfaction in the civilian labor market. The difference in satisfaction does not relate to the type of individual recruited, but to selected aspects of the job itself.

Vocational training earns small premiums in the military as compared to the civilian labor market. The small size of rewards for vocational training in the military suggests strongly the continued need for reenlistment bonuses to keep the military competitive with the civilian labor market.

Consideration should be given to rewarding additional education if, in fact, education is perceived to be related to productivity in the military.

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**AGRICULTURE-BASED URBANIZATION**

Researcher: Associate Professor Arthur Gibb, Jr.

Sponsor: Naval Academy Research Council

In the typical developing nation, on the order of two-thirds of non-agricultural employment occurs in the towns and cities of the agricultural regions. This employment grows with agricultural growth and is the prime determinant of urban growth at this level. The growth of these towns and cities in turn helps determine the rate of rural migration to metropolitan areas.

This research defines the structure of urbanization in Thailand and Malaysia in the 1970s both functionally and geographically, using fulltime non-agricultural employment as the measure of urban activities. Non-agricultural employment is broken down as between agricultural and non-agricultural regions. That in agricultural regions is further disaggregated by regional centers (which are usually chartered cities), greater market towns (those classified as urban places), and lesser market towns (represented by the fulltime non-agricultural employment of areas classified as rural).

Analysis of labor force and other data confirms that in both Thailand and Malaysia it is necessary to look behind the rural-urban distinction in order to estimate and analyze agriculture-based urbanization. The case of Thailand is most clear. Though officially there are only 71 places classified "urban" (Bangkok and the 70 province capitals), there are also 703 district-level towns, which are acknowledged only as "sanitary districts." The province capitals, district towns, and lesser agriculture centers harbor over two-thirds of Thailand's fulltime non-agriculture employment. Whereas the "urban-rural" distinction suggests such employment is divided 50/50, this re-definition indicates a 30-70 split, agriculture-based towns and cities being shown to be more than twice as important as industrial centers in the urbanization and employment generation processes. These results add support to similar findings from the earlier analysis of agriculture-based employment and urbanization in the Philippines.

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**DEFENSE INDUSTRY DIVERSIFICATION AND MONOPSONY POWER**

**Researcher: Assistant Professor Thomas A. Zak**

**Sponsor: Naval Academy Research Council**

It is believed that firms in the defense industry are not as dependent upon defense sales as they once were. Many defense contractors are now elements of large multiproduct, multimarket organizations rather than independent corporate entities. As the sole buyer of a firm's output, the Department of Defense (DOD) can obtain more favorable terms than if defense sales are a small percentage of a firm's business. Thus, diversification may significantly alter the balance of bargaining power between the government and defense contractors. What effect have changes in diversification had on DOD's contract bargaining power? This research focused on the extent of diversification in the defense industry and examined how diversification has affected price-cost gaps, cost overruns, and delivery lags.

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## AEROSPACE TRANSITION PROGRAM FOR DISPLACED WORKERS IN CALIFORNIA

Researcher: Assistant Professor William R. Bowman

The Department of Labor has recently proposed to phase out its Comprehensive Employment and Training Act (CETA) program by FY 1983 and to replace it with a private sector-based Employment Training Plan (ETP). As currently proposed, public funding in FY 1983 for ETP would be budgeted at \$2 billion (far less than the \$6 billion CETA FY 1981 expenditure level) which would be added to private sector resources and funding from organized labor and/or consortiums of private sector employers for the direct provision of training to select target groups.

A new initiative for the Department's ETP should be the provision of relatively inexpensive job-search training for displaced workers through a "Private Sector Industry Transition" (PSIT) program. This program would address the growing problems associated with the industrial transitions that characterize our dynamic economy. The thrust of this approach is to stimulate direct private-sector initiatives in the industrial transition process through the ETP which build on the incentives confronting both declining and expanding firms to facilitate smoother transitions. It also makes maximum use of the specific knowledge such firms possess. This approach has the potential for a cost-effective linkage system among declining and expanding firms. The role of the public sector would be one of providing technical assistance to PSIT programs within a defined region for the purpose of facilitating the transition of experienced workers between the two sectors.

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UNEMPLOYMENT CHECKS DISCOURAGE JOB HUNTING IN MIDLAND, PENNSYLVANIA

Researcher: Assistant Professor William R. Bowman

When Crucible Steel, Inc. was forced to idle more than 1,000 workers at its steel mill in the Ohio River valley midway between Pittsburgh and Youngstown, it joined with the local chapter of the United Steel Workers of America to help the laid-off employees. Working with the union, the Beaver County (Pennsylvania), Private Industry CETA offices in Ohio and Pennsylvania and the federal government, the company set up a job-search club. Participants were given all the essential resources for finding new jobs. They spent four days learning how to assess their skills, how to develop resumes and job leads, and how to interview. They then were given unlimited access to the job resource center, which was equipped with newspapers from 25 cities, yellow pages from 40 cities, and WATS phone lines. The high placement results underscore the program's merits. The 57 who found jobs are earning an average hourly wage of \$8.63. Seven of those who joined the program after being laid off last summer have found jobs paying an average of \$8.18 per hour.

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SELECTED PROVISIONS OF THE ECONOMIC RECOVERY TAX ACT OF 1981

Researcher: Associate Professor Rae Jean B. Goodman

This research provides an analysis and an implementation-time chart of selected provisions of the Economic Recovery Tax Act of 1981. The changes in the individual income tax structure are aimed to decrease the burden of taxation, to remove some biases in the income tax structure, to decrease the cost of earning income, and to provide some relief for the housing sector. The business tax provisions decrease the tax burden on small businesses, provide greater incentives for investment and research, and aid financially-troubled financial institutions. The savings and retirement account provisions provide increases in incentives to save and provide incentives for retirement income to supplement social security. The estate and gift tax changes likewise encourage savings and investment.

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TAX-BASED PROPOSALS TO STIMULATE SAVINGS AND MORTGAGE LENDING

Researcher: Associate Professor Rae Jean B. Goodman

This research examined eight proposals designed to affect savings flows primarily through changes in the tax system. The proposals examined are (1) the Reagan economic program, (2) extension of IRAs, (3) extension of interest and dividend exclusions, (4) tax-exempt savings certificate, (5) tax-deferred annuities, (6) an individual housing account, (7) an education savings account, and (8) mortgage revenue bonds. Each proposal is discussed and accompanied by estimates of its effects on total savings flows, savings flows to thrift institutions, mortgage flows, housing starts, and Treasury revenue where available.

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IMPACT ON S&Ls OF THE SAVINGS PROVISIONS OF THE ECONOMIC RECOVERY TAX ACT OF 1981

Researcher: Associate Professor Rae Jean B. Goodman

There are three provisions of the Economic Recovery Tax Act of 1981 which will affect the thrift industry directly: (1) the tax-exempt savings certificate, (2) partial exclusion of interest, and (3) the expansion of IRA and Keogh accounts. This paper describes the three programs and analyzes the impact on savings and loan associations.

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A METHODOLOGY FOR ESTIMATING THE IMPACT OF FOREST MANAGEMENT ON RECREATION BENEFITS

Researcher: Assistant Professor F. Reed Johnson

The last fifteen years have seen major advances in the theory and measurements of the benefits of outdoor recreation. Although there remain areas where researchers can contribute in refining recreation demand applications, particularly in cases where there are changes in the quality attributes to recreation sites, the methods are well enough developed to be of use to public land managing agencies.

The United States Forest Service (USFS) has engaged in an impressive recreation-data-collection and reporting effort for nearly fifteen years. Under the requirements of the Forest and Rangeland Renewable Resources Planning Act (RPA), the National Forest Management Act (NFMA), and stricter budget evaluation procedures, there is now greater interest in analyzing recreation data to provide more useful information to USFS policy makers and managers.

This research establishes a set of criteria for identifying an outdoor-recreation-evaluation methodology suitable for USFS purposes, assesses the existing data capabilities of the agency, reviews available evaluation techniques, and proposes a specific technique to be adopted by USFS. Some illustrative examples are provided to demonstrate applications to Forest Service management and planning problems. The scope of this study did not permit full resolution of a number of practical problems. Such issues are identified for further study.

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**POLICY ISSUES INVOLVING MINERALS EXPLORATION IN ECOLOGICALLY SENSITIVE AREAS****Researcher:** Assistant Professor F. Reed Johnson

The Wilderness Act of 1964 allows initiation of mineral exploration and extraction activities in areas having wilderness characteristics subject to nonimpairment of wilderness values. Although valid existing rights will continue to be protected, new activities must cease at the end of 1983. While a number of claims have been staked in primitive areas since 1964 under provisions of the Mining Act of 1873, no new mineral leases have been approved in wilderness areas under the Mineral Leasing Act of 1920. The Secretary is currently faced with a series of decisions regarding management of primitive areas where information on both preservation and development values is limited. This research is limited to some conceptual issues involved in choosing between a restrictive and a permissive policy with respect to minerals exploration and extraction in primitive areas.

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**PERSPECTIVES OF A TOURING ECONOMIST: ALFRED MARSHALL IN THE U. S., 1875****Researcher:** Professor Clair E. Morris

Work continues on this project that was begun last year. It represents a report of a 19th century traveller to the U.S. and his impression of this country's economic system and its performance. The record which he made of his visit is in extensive handwritten notes and letters to his family. For more than three months he went into factories, mines, and workshops all over the land and observed wage rates, production methods, productivity rates, etc.

The intent of this study has been to uncover insights which Marshall might have had relative to the U.S. economy that have previously been overlooked. A reasonable objective would be a short journal article in a publication that specializes in history of economic thought.

More culling and sifting of archival material remains to be done along with a continuing review of the literature. Completion of the study is expected by the end of summer 1982.

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## PATTERNS OF TRADE IN THE SOUTH ATLANTIC BASIN

Researcher: Midshipman 1/C John R. Hatten

Adviser: Associate Professor Arthur Gibb, Jr.

This research project investigated the degree of economic interdependence among the nations of the South Atlantic Basin. Although intra-basin trade is growing, in absolute terms it is still too small to show up in published tabulations of trade flow data. Thus only the major trading nations--Argentina, Brazil, Nigeria, and South Africa--were considered in detail.

United Nations and United States published data were supplemented by data obtained directly from the Department of Commerce and several embassies.

Trade relations among the key basin member countries have grown appreciably over the past decade. Brazilian-Nigerian trade has grown from nothing to \$200 million annually. Trade between Brazil and Argentina has grown from \$300 million a year to over one billion dollars, a 300 percent increase. South Africa and Brazil have increased their total trade from \$20 million to over \$200 million, a 1,000 percent increase.

Over-all intra-basin trade has increased slightly as a proportion of total trade by these Basin nations. Argentina in particular has seen such trade increase from 8 percent to 10 percent of its total trade. Other trade patterns were more irregular than expected but generally trended upwards.

The research established that, although intra-basin trade had expanded rapidly as expected, its share of total trade had not expanded sharply, so rapid was the growth of trade in general. Thus it appears the South Atlantic basin is not yet distinctive as a trade area, its member nations continuing to be principally engaged in trade as a global basis.

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**ALTERNATIVE RECRUITMENT PROGRAMS FOR MILITARY SERVICE**

Researcher: Midshipman 1/C Timothy Metzler

Adviser: Assistant Professor William R. Bowman

A major problem that has continually plagued the military service is the recruitment of sufficient quantity and quality of manpower. Since 1973, the U. S. has relied on a voluntary approach as distinct from the conscripted armed forces of earlier period. The All-Volunteer Force (AVF), however, has been criticized for its failure to attract required numbers, especially of the quality needed in the high-technology modern world.

The major conclusions of the project are first, that a draft for the reserves may be necessary. Secondly, registration for active duty should be maintained. To switch to the draft now would not save the DOD money. To keep people in the military, many of the benefits that the military can expect such as reenlistment bonuses or schooling benefits must be improved. Given the chance, the AVF will continue to work, and as long as the option to AVF is some form of mandatory service, the AVF is the better choice.

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LIFE-CYCLE COST OF WEAPONS

Researcher: Midshipman 1/C Thomas W. Padden

Adviser: Assistant Professor William R. Bowman

Studies of the life-cycle expenditures for a particular weapons system can reveal astronomical hidden costs. Operations and maintenance costs of ownership can amount to as much as 50 to 80 percent of the total life-cycle cost (LCC) of the weapons system.

In researching this project, it became obvious that manpower considerations in LCC, though important, are not generally weighted as much as capital-input. Operational-manpower inputs, minimal when compared with maintenance-manpower inputs, are generally overlooked in most LCC models. A more complex model, required to analyze closely the manpower-requirements of maintenance, indicates that manpower considerations are of secondary importance to capital-input accounting in a vendor's LCC analysis.

Though LCC studies and models are integral components in the sale of, or search for, a weapons system, little is done with them once the weapon is bought or sold. The government has apparently never run a check on the validity of an LCC model at the end of the life-cycle of the system.

Finally, more effort should be placed on harmonizing the weapon and manpower procurement systems to ensure future efficiency. Weapons systems should not be allowed to influence manpower inputs to the extent that they now do.

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**THE EFFECTS OF TWO-STAGE LEAST-SQUARE REGRESSION**

Researcher: Midshipman 1/C John J. Scuteri

Adviser: Assistant Professor William R. Bowman

Time-series economic regressions use various independent variables in order to predict the value of a dependent variable. Ideally, all of the independent variables should be exogenous to the system of equations in the model. However, there are usually endogenous variables involved. These endogenous right-hand-side variables are correlated with the error term over time. This procedure biases the estimate of the coefficients on the endogenous variables.

The object of this project was to calculate values of these endogenous variables through the use of other exogenous variables and then replace the newly-calculated variables back into the original model. The effect of the newly calculated variables on the model was then compared to the results of the original model.

A Two-Stage Least-Square regression technique was used to accomplish this objective. The dependent variable in the model was industrial production. The two endogenous variables were recalculated through the use of other exogenous variables. The newly calculated values for GNP and employment were then placed back into the original equation in order to examine the effects of the newly-calculated values.

It was found that both GNP and employment became less significant in the second equation. However, the coefficients for both variables changed considerably. The coefficient for GNP changed from .663271 to -.263116; the coefficient for employment from .463336 to 1.62147 showing that there probably was some bias present in the first regression.

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**MILITARY MANPOWER PROBLEMS**

Researcher: Midshipman 1/C Myron Simons

Adviser: Associate Professor Roger D. Little

This project involved the analysis of a substantial portion of the literature on the All-Volunteer Force from its inception to the present. Beginning with the Gates Commission Report and ending with the proceedings of the American Assembly Conference, "Military Service in the United States" (September 17-20, 1981), the research identified areas of conflict and disagreement between the force as it was originally envisioned and its current status. The outlook for the 1980's, particularly the demographic factors facing the services, was also studied.

A significant part of the course involved research into the promotion pattern of OCS, NROTC, and USNA-prepared officers. Data collected in 1979 by the RAND Corporation was used to test the hypothesis that promotions of USNA graduates, other things held equal, lagged behind those for the other sources for officers in pay grades O-4, O-5 and O-6. Preliminary results suggest that USNA graduates do receive slightly slower promotions to these ranks when year group, educational level, MOS, and marital status are held equal.

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**THE NAVY OF THE EIGHTIES: COMPETITION IN THE LABOR MARKET**

Researcher: Midshipman 1/C Craig D. Uffman

Advisers: Associate Professor Roger D. Little

This paper examines the manpower problem in the armed forces, compares the competing philosophies for future compensation policies, and attempts to determine the proposal that best meets the needs of the Navy. It concludes that the Navy must shed itself of its draft-era mentality if it is to solve its manning problems. Competition in the labor market will be a fact of life for the Navy of the 1980's and appeals to the patriotic spirit are unfortunately, not nearly as effective in that market as are appeals to the pocketbook.

The present system of compensation is allocatively inefficient, results in a chronic shortage of high-skilled personnel and overinvestment in low-skilled personnel, and is based upon equity concerns that are not justified by empirical observation of fleet behavior. It is clear that differential monetary rewards are highly successful for retention and that competitiveness maximizes manpower readiness while minimizing costs.

Principles of compensation should be developed. Pay adjustments should be made solely for the purpose of meeting manpower requirements, with due regard to various labor market equilibria. Base pay should be de-emphasized and existing differential programs should be expanded. The Navy should ask Congress for increasing discretionary power in the allocation of pay raises. A decreasing percentage of each pay raise should be allocated to base pay, while the majority should be allocated to special pays and bonuses.

The Navy of the future will have to compete in the marketplace for the skills it needs, and it must compete as efficiently as possible. Without question, the Navy must adapt the competitive approach to compensation in order to meet its manpower requirements in the 1980's.

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BOWMAN, William R., Assistant Professor, "Private Sector Initiatives for Displaced Workers in Manufacturing: a Lesson from the Steel Sector," Prepared statement, Subcommittee Hearings on Employment and the American Automobile Industry, 1982, U.S. Senate, 11-12 January 1982, Congressional Record, pp. 215-236.

The recent worker displacement in the auto industry closely parallels the structural changes taking place in the steel sector. Older plants are no longer competitive and are being discarded or significantly downsized with new labor-saving technological improvements. The immediate costs of this transition are falling upon the shoulders of labor at a time when the government has made an apparent shift in the extent of active support for the jobless. Special programs for displaced workers are being eliminated or cut back severely and local employment service offices are being closed. As a result of these structural changes, one must search for new private sector initiatives that can fill the void in government re-employment assistance programs. One such program has been developed through the joint efforts of union and business leaders for a job search assistance program designed especially for permanently displaced workers from a Crucible steel plant outside Pittsburgh.

This paper first describes the causes of the permanent layoff at Crucible and outlines the private sector initiatives that were designed to tap community and local and state government re-employment programs. A brief assessment of the success of this initiative is given, and six basic steps, which are based upon the Midland Pilot Project for the displaced steel-workers at Crucible, for active union support of such private sector initiatives are outlined. The union role in plant closures must be addressed in future negotiations with management in face of the inevitable decline in union membership of many of our basic industries such as steel, autos, and rubber.

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GIBB, Arthur, Jr., Associate Professor, "Agriculture-Based Cities in Southeast Asia," Annuals, Asian Studies Association, 3(December 1981), 89.

The hierarchy of urban places in populous developing nations such as those of Southeast Asia can be usefully characterized in several tiers. First are the primary cities, typically metropolitan centers of over one million in population. Next are secondary cities of several hundred thousand to a million. Third are agricultural regional centers which range from 20,000 to 100,000 and are chartered cities. And, last are two tiers of subordinate agricultural towns--sub-region centers and locality towns.

This paper argues that agricultural regional centers are characteristically service centers--rather than growth poles--whose growth is dependent upon increased demands from below for services--from subordinate market towns and, indirectly, from the farm communities. It follows from this that agriculture policies, not industrial policies, are likely to be the key to influencing the pattern of urbanization.

The discussion focuses on evidence from studies of two rice-growing agricultural regions in Central Luzon and West Malaysia.

It is clear that the urban growth experienced by Cabanatuan City and Alor Setar during the late 1960's and early 1970's was almost entirely agriculture-based. Such manufactured exports as there were from the region were so small that the income generated by them could not have had a significant impact on the expansion of the consumer industries and public services that accounted for the bulk of the urban activities.

The broader implication of the evidence presented in this paper is that agricultural regional centers are likely to continue to be essentially agriculturally-based cities for some years in the future.

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JOHNSON, F. Reed, Assistant Professor, "Federal Project Evaluation and Intangible Resources: The Tellico Dam," Resource Policy, 7 (September 1981), 3, 197-205.

A model of resource evaluation incorporating reversibility of actions and substitutability for resource services is presented, along with associated decision criteria. The model extends and generalizes the Krutilla-Fisher procedure for evaluating unique resources. The more general technique is used to assess the official analysis of the Tellico Dam project in eastern Tennessee. In terms of measured values, the preservation option is shown to be superior to development only under extreme assumptions. The existence of substantial unmeasured preservation values in the Tellico case strengthens the environmentalist position, however, particularly since net benefits of development are apparently negative.

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JOHNSON, F. Reed, Assistant Professor co-author , "Valuing Amenity Resources in the Presence of Substitutes," Land Economics, 54 (November 1981), 4, 526-535.

The current amenity value provided by a natural resource--recreation, sightseeing, educational, or research potential--is generally unknown and difficult to estimate. The rate at which this changes over time, however, can often be approximated by estimating the growth in various determinants of demand for the amenity resource. Thus, it is possible to calculate the present value for any conjectured value of initial period benefits. This paper extends the Krutilla-Fisher valuation technique to cases where the resource in question is not unique, as assumed in previous studies, but has recognized substitutes. Vertical and horizontal demand shifts are not independently attributable to the influences of income and population growth, respectively. Consequently, Krutilla-Fisher's preservation benefit estimates are overstated.

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PRESENTATIONS

ECONOMICS DEPARTMENT

FREDLAND, J. Eric and Roger D. Little, Associate Professors,  
"Socioeconomic Status of World War II Veterans by Race:  
An Empirical Test of the Bridging Hypothesis," Annual  
Meeting of the Eastern Economic Association, Washington, D.C.,  
30 April 1982.

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FREDLAND, J. Eric and Roger D. Little, Associate Professors,  
"Socioeconomic Characteristics of the All Volunteer Force:  
Evidence From the National Longitudinal Survey, 1979,"  
Presented to the Office of the Naval Research Manpower R&D  
Committee, Arlington, Virginia, 24 September 1981.

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JOHNSON, F. Reed, Assistant Professor, "Multiple Destination Bias  
in Travel Cost Value Estimated," Western Economic Associa-  
tion, San Francisco, June 1981.

\*\*\*\*\*

JOHNSON, F. Reed, Assistant Professor, "Economic Valuation of  
Potential Scenic Degradation at Bryce Canyon National  
Park," Conference on Visual Values, National Park Service,  
Electric Power Research Institute, and American Petroleum  
Institute, Dillon, Colorado, May 1982.

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WHITAKER, A. Royall, Associate Professor, "Interest on Fully  
Funded Demand Deposits," Annual Meeting of the Eastern  
Economic Association, Washington, D.C., April 1982.

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ZAK, Thomas A., Assistant Professor, co-author, "Wages, Fringes,  
Unions, Union Membership and Industry Concentration,"  
Federal Trade Commission Seminar, Washington, D.C.,  
5 March 1982.

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## LANGUAGE STUDIES DEPARTMENT

*Professor John D. Yarbro, Chairman*



form. Another book, on a Spanish literary figure, is now in press.

Funding has come from the Defense Intelligence Agency, the Naval Intelligence Support Center, and the Naval Academy.

The Naval Academy Computing Center has continued to provide major support for faculty researchers.

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**SIMILARITIES BETWEEN JEAN-JACQUES ROUSSEAU'S HUMANISTIC FORMATION AND CLASSICAL EAST-ASIAN IDEALS**

Researcher: Assistant Professor Steven T. Brent

Sponsor: Naval Academy Research Council

Of the three main East Asian philosophies examined in the light of Rousseau's humanistic thought, Buddhism, rather than Hinduism or Shinto, has offered the most significant parallels.

Buddhism was in part born out of a reaction against the excesses and corruption of society, a genesis highly reminiscent of Rousseau's rejection of eighteenth century Parisian society. Buddhism attempted to free mankind from the self-destructive compulsiveness of "tānha" which society subtly implants in everyone. The Buddhist concept of "tānha" as an obstacle to moral progress corresponds to Rousseau's preoccupation with the control and sublimation of the passions. It particularly corresponds to the behavioral component in the negative phase of the "première éducation" in Rousseau's treatise, Emile.

In addition, Buddhism's search for universal harmony in a mystical unity with nature finds striking parallels in Rousseau's ideal of "l'homme naturel," natural man.

The researcher studied Rousseau documents and critical analyses of his humanistic views and ideals at the Bibliothèque Nationale in Paris during the summer of 1981. He has carried on studies of East Asian philosophies during the past year and his current research suggests that key aspects of Confucianism, particularly in regard to pedagogical precepts, correspond even more strikingly with the humanistic ideals and world views of Rousseau.

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**THE ALLEGORICAL DRAMA OF CALDERÓN DE LA BARCA (1600-1681): A SEMIOTIC APPROACH TO THE AUTO SACRAMENTAL.**

Researcher: Assistant Professor Sharon G. Dahlgren

Sponsor: Naval Academy Research Council

Among the more significant works of the Spanish Golden Age are Calderón's autos sacramentales, allegorical one-act plays performed in celebration of the mystery of the Eucharist. They have been studied extensively for their religious message, but not for the ties between their artistic language and its dramatic function. This study will examine the auto as a communicative system, using the techniques of semiotics, the study of signs

advanced by the Swiss linguist Ferdinand de Saussure. The aim is to increase understanding of the communicative power they held, both in Spain and abroad, since they represent the main religious and philosophical concerns of the seventeenth century.

The researcher will identify key structural linguistic bonds and relationships to dramatic function, aiming to clarify the role of symbolism and language in the plays. To this she will combine her hypothesis on the function of syntactic configurations developed in her book, Petrarch and Garcilaso: A Linguistic Approach to Style, with the modèle constitutionnel, formulated by the French semiotician, A. J. Greimas.

The latter model extends the structuralist notion of the binary nature of language as a system of opposing components. It also tries to relate corresponding structures on differing semiotic levels, such as literary constructs and economic patterns. The researcher's model refers to the two dominant levels of syntax responsible for textual cohesion; "context," or the structure of similarity and continuum; and "contrast," or the structure of dissimilarity and discontinuum. In particular, this study will address the plays dealing with a philosophical or theological idea, namely El gran teatro del mundo, La vida es sueño, and La cena de Baltasar. It will include the relationships between verbal and non-verbal sign systems, both powerful devices in certain of these plays.

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SPONSORED RESEARCH

LANGUAGE STUDIES DEPARTMENT

AUTOMATED BIOGRAPHIC ANALYSIS OF CHINESE MILITARY LEADERSHIP

Researcher: Associate Professor Daniel T. Y. Lee

Sponsor: Defense Intelligence Agency

This is an ongoing project of research on biographic characteristics and career patterns of the military leaders in the People's Republic of China. It employs English-text summaries prepared according to strict syntactical rules with embedded computer flags permitting the computer to search biographies and develop summaries by characteristics, or to link logically different leaders as they progress through their careers. As data accumulate, it is expected that hierarchical clustering techniques will establish clear patterns of ascendancy.

Following additional research in Taiwan and Hongkong in the summers of 1981 and 1982, the researcher has added 144 new biographies to this project during the past year. He has also updated practically all of the previous entries. The total number of leaders included now stands at 540.

Associate Professor R. G. Tomlinson of the Political Science Department is serving as research associate for this project.

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A STUDY OF DIDACTIC POETRY IN FIFTEENTH-CENTURY SPAIN: JUAN DE MENA'S COPLAS DE LOS SIETE PECADOS MORTALES AND SECOND AND THIRD CONTINUATIONS

Researcher: Assistant Professor Gladys Rivera-La Scala

Sponsor: Naval Academy Research Council

Juan de Mena (1411-1456) is one of the literary giants who led Spanish authors through the final phases of medievalism to humanism. His last work, a lengthy poem entitled Coplas de los siete pecados mortales, left unfinished at his death, stands as one of the finest examples of the medieval didactic tradition. It inspired Gómez Manrique and Pero Guillén de Segovia, both important poets of their age, and Jerónimo de Olivares to write continuations.

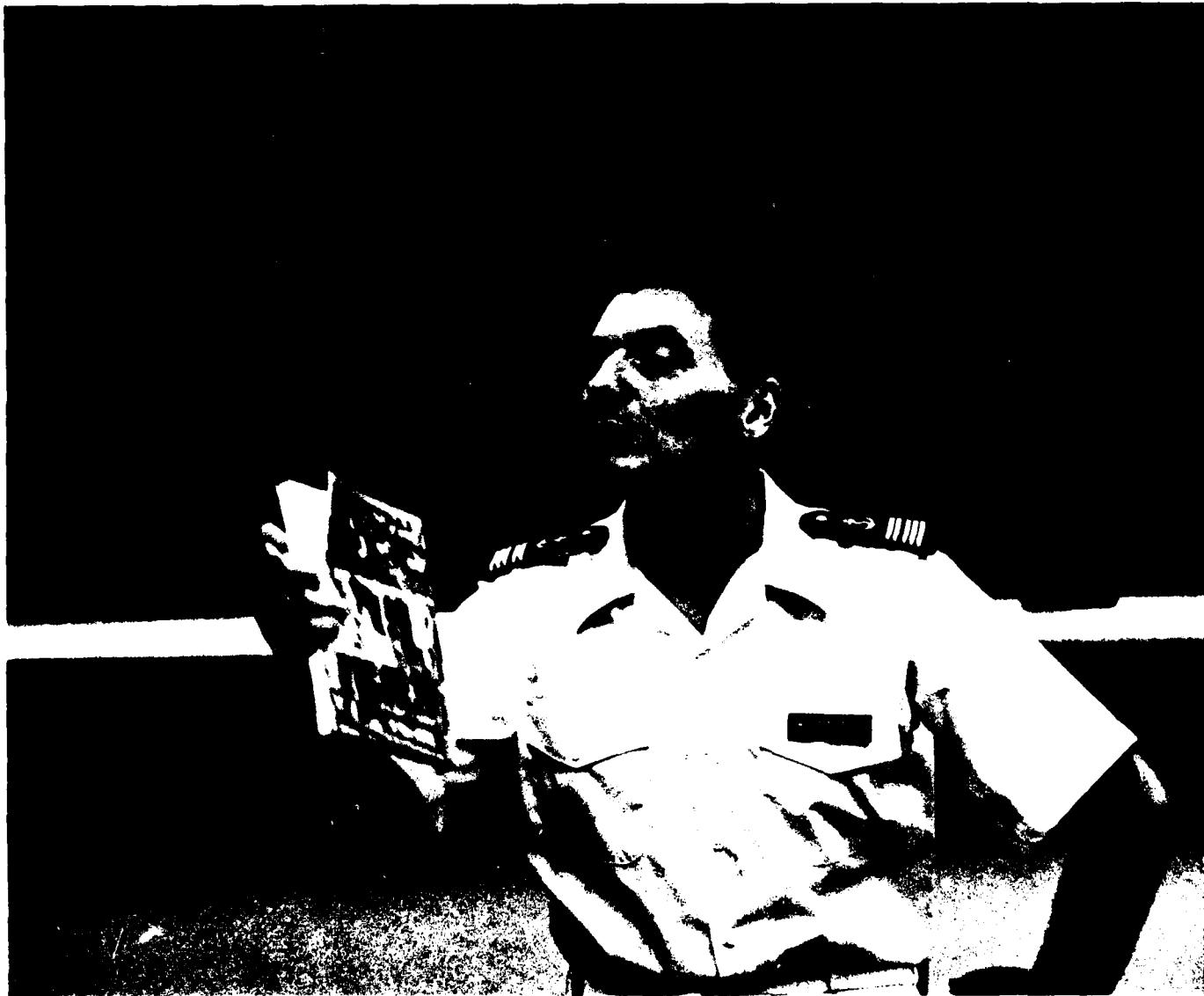
Volume I of the researcher's own overall study presents Mena's work and the First Continuation and is now in press. This year she has begun work on Volume II, which will include an intertextual analysis of the main poem and its later

SPONSORED RESEARCH

LANGUAGE STUDIES DEPARTMENT

continuations, along with discussion of the authors' contributions to the cultural, literary, and linguistic traditions of the times. She has also studied and collected primary source materials from Spanish and French libraries, in order to prepare a critical edition of the Second and Third Continuations. The finished work will provide students of Spanish literature with the first critical edition and study of Mena's famous poem and all its continuations.

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THE THEATER OF JACOB MASEN, S. J.

Researcher: Associate Professor Michael C. Halbig

This project is a continuation of the researcher's studies on Masen originally sponsored by NARC. Having completed the manuscript of a proposed Volume I, including translations of three plays and selections from the *Poetics*, he has collected materials from German and Italian libraries on this author's life and his involvement in ecclesiastical theater in the years 1630-1660. During the past year he has worked at evaluating and organizing these materials with the aim of producing a second volume, to present Masen's life and milieu, the circumstances of his literary and theatrical activities, and critical analyses of his plays and poetry.

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PUBLICATIONS

LANGUAGE STUDIES DEPARTMENT

HALBIG, Michael C., Associate Professor, Claude P. Lemieux , Professor (Retired), and Irmeli S. Makela , Lieutenant Commander, USN, in collaboration with the Translation Division of the Naval Intelligence Support Center, Russian-English Shipbuilding Dictionary: A Reversal of P. A. Favorov's "Anglo-Russkiy Korablestroitel 'nyy Slovar'", Washington, D. C.: Naval Intelligence Support Center, 1982.

This work is a reversal of Favorov's original English-Russian Shipbuilding Dictionary published in 1967 by the Military Publishing House in Moscow. The original contained about 30,000 terms pertaining to ship design and construction; shipboard systems, gear, machinery, and electrical equipment; shipboard weapons; ship damage control, shipbuilding technology and theories; navigation; and other related subjects, such as the latest terminology on air-cushion vehicles and hydrofoils, and ships with nuclear power plants and missile armament. Some of the Russian terms are renderings or definitions of English shipbuilding terms rather than precise Russian equivalents, primarily because the specific content is not found in Russian shipbuilding terminology.

This dictionary project was a collaborative effort between the Naval Intelligence Support Center and a faculty team from the Language Studies Department, U. S. Naval Academy. Associate Professor Michael C. Halbig originated the project. The Naval Academy Computer Center was used for the final alphabetization and printout. Mr. Carlos R. Moctezuma of the Translation Division, Naval Intelligence Support Center, was responsible for the final editing and proofreading of the 50,000-term computer printout.

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PRESENTATIONS

LANGUAGE STUDIES DEPARTMENT

RIVERA-LA SCALA, Gladys, Assistant Professor, "The Sermon in Late Fifteenth-Century Didactic Poetry," Northeast Modern Language Association Convention, New York City, 4 April 1982.

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YARBRO, John D., Professor, "Naval Academy Curriculum Development, 1960-1970," Naval Academy Intercollegiate Conference on Liberal Learning in a Technical Curriculum, U. S. Naval Academy, Annapolis, 18 March 1982.

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## POLITICAL SCIENCE DEPARTMENT

*Professor G. Pope Atkins, Chairman*



The faculty of the Political Science Department and midshipmen majors continued to conduct extensive research in all fields of the discipline during Academic Year 1981-1982. Research conducted in this Department reflected a wide range of interest and expertise in the fields of political theory and methodology, American politics, comparative politics, and international politics and foreign policy. Ten faculty members and seven midshipmen pursued forty-two original projects. They were undertaken in the areas of energy problems and U. S. foreign policy, U. S. congressional politics, strategic arms limitations, the North Atlantic Treaty Organization, civil-military relations, political

decision-making, U. S. oceans policy, international terrorism, student internship programs, liberal education, the Rapid Deployment Joint Task Force, and comparative and international politics in South Africa, the Middle East, Southeast Asia, Latin America, the Soviet Union, Federal Republic of Germany, Poland, Iran, Saudi Arabia, and the Dominican Republic. Among the published results were six articles, one book review, and a newspaper commentary. Accepted for publication and in press were two books and six articles/chapters. Eleven reports were submitted, a computer data bank completed, and nine papers were presented at professional conferences. In addition, faculty members regularly lectured, led seminars, and served as panelists at other academic institutions, war colleges, and civic organizations. In sum, the Political Science Department continued to maintain a research environment that encouraged professional growth of the faculty, allowed outstanding midshipmen to pursue special studies, and supported teaching excellence.

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SPONSORED RESEARCH

POLITICAL SCIENCE DEPARTMENT

THE VULNERABILITY OF U. S. ENERGY SUPPLIES AT MILITARY  
INSTALLATIONS OVERSEAS

Researcher: Professor Charles L. Cochran

Sponsor: Los Alamos National Laboratory

This concept paper is designed to develop the problem of the vulnerability of energy supplies at U. S. military installations overseas. The primary focus is on petroleum products as a mobility fuel problem. However, solid fuels, electricity, and alternative fuels were also considered. The study examines the critical nature of military vulnerability to sabotage, terrorism, civil unrest, and conventional war and the need to provide energy for critical military operations.

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COMPUTERS IN CONGRESS: THE POLITICS OF INFORMATION

Researcher: Associate Professor Stephen E. Frantzich

Sponsor: Naval Academy Research Council

Originally titled "The Impact of Congressional Career Orientations on Congressional Behavior," this study has been revised and expanded as indicated in the new title. Modern information technology is revolutionizing all segments of society, but little attention has been paid to the antecedents and consequences of this phenomenon for political institutions. The emphasis of this book is on the political aspects of computer adoption by the Congress, focusing on the process of adoption and the personal, public policy and power payoffs of new technology. While the U. S. Congress provides the setting for analysis, generalizations concerning changing information availability apply to a wide range of social institutions.

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SPONSORED RESEARCH

POLITICAL SCIENCE DEPARTMENT

US/USSR STRATEGIC ARMS LIMITATION TALKS: IMPLICATIONS FOR THE SECURITY OF THE FEDERAL REPUBLIC OF GERMANY

Researcher: Assistant Professor Gale A. Mattox

Sponsor: Fulbright-Hayes Fellowship and Institute for the Study of World Politics at the University of Virginia

This doctoral dissertation was completed for the University of Virginia and is subsequently being updated and edited for publication in book form. It examined military and political issues raised in the Strategic Arms Limitation Talks (SALT) to determine their impact on the security of the Federal Republic of Germany. The thesis was that US/USSR negotiations on strategic arms control had significant implications for the security of the Federal Republic in the perception and redefinition of the FRG role in the security of the European continent. While SALT was not the cause of that redefinition, the SALT process has reflected the military and political circumstances which made a more prominent German role necessary and desirable. The objective of the research was to assess that German role and its importance for future Atlantic Alliance relations.

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COMPUTER-BASED INDICATORS OF CONFLICT AND CHANGE IN SOUTHERN AFRICA

Researcher: Assistant Professor Helen E. Purkitt

Sponsor: Naval Academy Research Council

Most analyses of the international implications of recent changes in Southern Africa are narrative and impressionistic. While these analyses provide rich source materials and insights into the dynamics of specific regional conflicts, they tend to raise unresolvable controversies about the appropriate substantive conclusions and policy lessons to be derived from recent political changes in this region. Major shortcomings in past research, identified during the first phase of this research, include the use of implicit conceptual perspectives, informal analytical heuristics and diffuse methodologies that are often difficult to replicate or use as the basis for additional research. To overcome some of these weaknesses, a more comprehensive conceptual framework that incorporates key characteristics of four major theoretical perspectives (the global, regional, national and world system) was developed and applied in a series of case studies of the international

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POLITICAL SCIENCE DEPARTMENT

implications of the Angolan Civil War. The findings from these case studies were then used to develop an integrated conceptual framework. This expanded framework has been used to develop, test and refine a policy-relevant computer-based methodology to monitor and assess the international implications of recent political changes in Southern Africa.

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**POLITICS IN POLAND: SECURITY VS. DEMOCRACY**

Researcher: Assistant Professor Arthur R. Rachwald

Sponsor: Naval Academy Research Council

Originally titled "Domestic and International Implications of the Summer 1980 Workers' Revolt in Poland," this study has been expanded to address the nature of the Polish state that emerged after World War II. The country's geographic configuration, political and economic system, ethnic composition, and international affiliations were all shaped by the Soviet Union. The domestic system in Poland must be kept in symmetry with the international system, which in Eastern Europe is decisively in the Soviets' favor. Consequently, any attempt to erode the Soviet influence by indigenous developments is regarded by Moscow as a threat to its security and suppressed. The most recent revolt in Poland brought with full clarity the Soviet policy, which subordinates the national interests of the East European countries to the interest of the Soviet state. As in classical drama, there are three acts to the Polish crisis: (1) a search for partnership between Solidarity and the communist state; (2) polarization of a third force; and (3) the "knock-out" solution, which appears to be the "lesser evil" to the consequences of free elections; that is, Soviet military intervention and the reduction of Poland to the status of a Soviet republic.

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## THE REORIENTATION OF U. S. POLICY TOWARD LATIN AMERICA

Researcher: Professor G. Pope Atkins

This essay will appear in Latin America & Caribbean Contemporary Record (Holmes & Meier, 1983). It deals with President Reagan's resolve to bring basic changes to U. S. policies toward Latin America. In contrast to his predecessor, President Reagan emphasized East-West conflict in the region. He deemphasized human rights as the basis for relations, resuscitated arms-transfers to policy purposes, and revised the approach to nuclear nonproliferation. The Reagan administration chose to concentrate on the Caribbean area. Consequently, with the exception of Mexico and, to a degree, Argentina, U. S. efforts initially focused on small countries. Relatively little attention was paid to the major nations, most notably Brazil, outside the Caribbean context.

President Reagan's first year of dealing with Latin American affairs seemed to be a matter of ideology in search of policy. His conservative government succeeded in reorienting the context of policy, but substantive changes were not as extensive as its rhetoric had anticipated and continued to declare. Complex situations, domestic politics, and foreign reactions not only constrained U. S. action but forced a broadening of the initial approach. In the Caribbean Basin, the administration evolved an "initiative" that included support for elections, societal reform, and economic cooperation for development. Unanticipated crises, especially Anglo-Argentine military conflict in the South Atlantic, fundamentally altered evolving relationships and forced a recalculation of U. S. policies.

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## CONGRESS AND COMMUNICATIONS

Researcher: Associate Professor Stephen E. Frantzich

This book chapter, commissioned by the Academy of Political Science, analyzes the impact of the communications revolution on Congress. Primary focus is on the battles over television coverage of chamber proceedings and the adoption of computerized information-management during the last decade, and on the implications such changes have on power relationships, representation and policy outcomes. The work has been completed and is awaiting publication.

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INDEPENDENT RESEARCH

POLITICAL SCIENCE DEPARTMENT

CONGRESS IN THE COMMUNICATIONS AGE

Researcher: Associate Professor Stephen E. Frantzich

This book-length manuscript analyzes the interaction between congressmen and their constituents in light of recent changes in communications technology. The advent of such technologies as computerized letters, electronic mail, cable television coverage of Congress, and interactive television all portend dramatic changes in Congress' representational role.

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IMPROVING THE ACADEMIC VALIDITY OF INTERNSHIP PROGRAMS

Researcher: Associate Professor Stephen E. Frantzich

This completed book-chapter, commissioned by Schenkman publishers, will be part of a larger book on the use of internships as learning devices. This chapter focuses on practical methods by which the internship can be used to supplement classroom material and help bridge the gap between political theory and political reality.

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ABU ESHAQ INJU

Researcher: FSO-4 John Limbert

Abu Eshaq bin Mohammad Shah Inju ruled Fars, Isfahan, and the Persian Gulf coast from 743/1343 until his execution in 758/1357. He came to power in the bloody anarchy that followed the death of the last Mongol ruler of Iran. Although his capital at Shiraz was famous for its poetry and scholarship during his reign, his rule was taken up mostly by warfare with the neighboring Mozaffarid dynasty. Abu Eshaq's fame rests mainly on his patronage of the poet Hafez and of miniature painters of the Shiraz school. He also endowed a major rebuilding of the library of the old mosque of Shiraz.

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**IRAN: TRADITION AND TURMOIL**

Researcher: FSO-4 John Limbert

Iran is the only Middle Eastern state to have preserved its national identity through the upheavals of the Arab, Turkish, and Mongol invasions. Modern Iran is the heir to the richest culture in the Middle East--a culture that penetrates far beyond that state's political boundaries. Afghanistan, Turkey, the Eastern Arab states, the Indian sub-continent, Soviet Central Asia, and the Caucasus have all been parts of the Iranian cultural empire. This book seeks elements of continuity in Iranian society from pre-Islamic times to the turmoil of the Islamic Republic. It discusses the persistence of religion as a dominant force in politics and society; the attraction of unorthodox doctrines such as Mazdakism, Baha'ism, and revolutionary Shi'ism; the tradition of strong, charismatic leadership under various names; and the constant problem of ruling peoples of diverse tribal, religious, and linguistic affiliation. This work looks for the explanation of recent political changes in conditions peculiarly Iranian. It examines the society emerging from the revolution and some of its new institutions: the revolutionary guards, the assembly, the neighborhood committees, and the Friday prayer leaders. Focusing on the continuing tension between pragmatism and revolutionary ideology, it discusses the possible direction of events when Iran begins rebuilding its economy and establishes stable political institutions.

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**THEATER NUCLEAR-FORCE MODERNIZATION WITHIN NATO**

Researcher: Assistant Professor Gale A. Mattox

This project analyzes and assesses the present debate within NATO over the modernization of theater nuclear forces to determine its short- and long-term implications for the Atlantic Alliance.

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SUMMARY OF RESEARCH ACTIVITIES ACADEMIC DEPARTMENTS  
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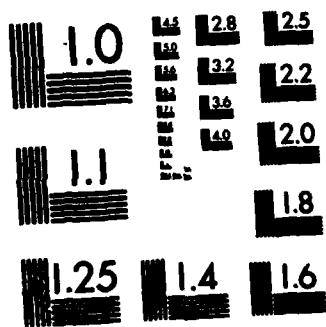
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**WOMEN IN THE ARMED FORCES: THE DEBATE IN THE FEDERAL REPUBLIC OF GERMANY**

**Researcher:** Assistant Professor Gale A. Mattox

This study is a review of the arguments presented in the current debate over manpower shortages and declining numbers of eligible draftees for the German armed forces.

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**DETERRENCE AS AN ANTI-TERRORIST STRATEGY AND PROBLEM-SOLVING LOGIC FOR COPING WITH DEVIANTS IN WORLD SOCIETY**

**Researcher:** Assistant Professor Helen E. Purkitt

The purpose of this study was to examine the deterrence theory and problem-solving logic used in most governmental responses to terrorism. Research findings on decision-making under conditions of uncertainty were used to explain the short-term crisis management response by governments. An alternative strategy based on a more open-ended sequential decision making process was presented as an alternative strategy for coping with diverse terrorist threats. The work has been completed.

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**AN EXPERIMENT IN INDIVIDUAL VS. SMALL GROUP PROBLEM SOLVING**

**Researcher:** Assistant Professor Helen E. Purkitt

Eight additional runs of this small group experiment were completed during 1981-1982. Additional runs completed by the end of next year will provide an adequate data base for analysis. The purpose of this study is to identify differences in the problem-solving behavior of individuals and small groups. Two different problem-solving tasks, the promotion of Naval officers and defense allocations for a fictitious country are used to identify differences in problem-solving behavior across different types of tasks. The results of these experiments are designed to increase understanding of the dynamics of small group problem-solving behavior.

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**U. S. FOREIGN POLICY TOWARD SOUTHERN AFRICA**

**Researcher:** Assistant Professor Helen E. Purkitt

This book-length manuscript on U. S. foreign policy toward Southern Africa evaluates the significance of recent political changes in Southern Africa for U. S. national interests in the region from four distinct theoretical perspectives. The distinct and partially conflicting policy-lessons derived from each school of thought regarding important changes since the Portuguese withdrawal are identified and discussed in terms of future U. S. policy options toward the region.

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**THE FOREIGN POLICY OF POLAND**

**Researcher:** Assistant Professor Arthur R. Rachwald

This project is a book on the foreign policy of Poland since the establishment of the Communist regime in 1944. The major purpose of this study is to demonstrate that the foreign policy of Poland has been designed to achieve three major goals: (1) political and economic recovery; (2) permanent recognition of the Oder-Neisse line as an international border between Poland and Germany; and (3) security through alliance with the Soviet Union and the collective security system in Europe.

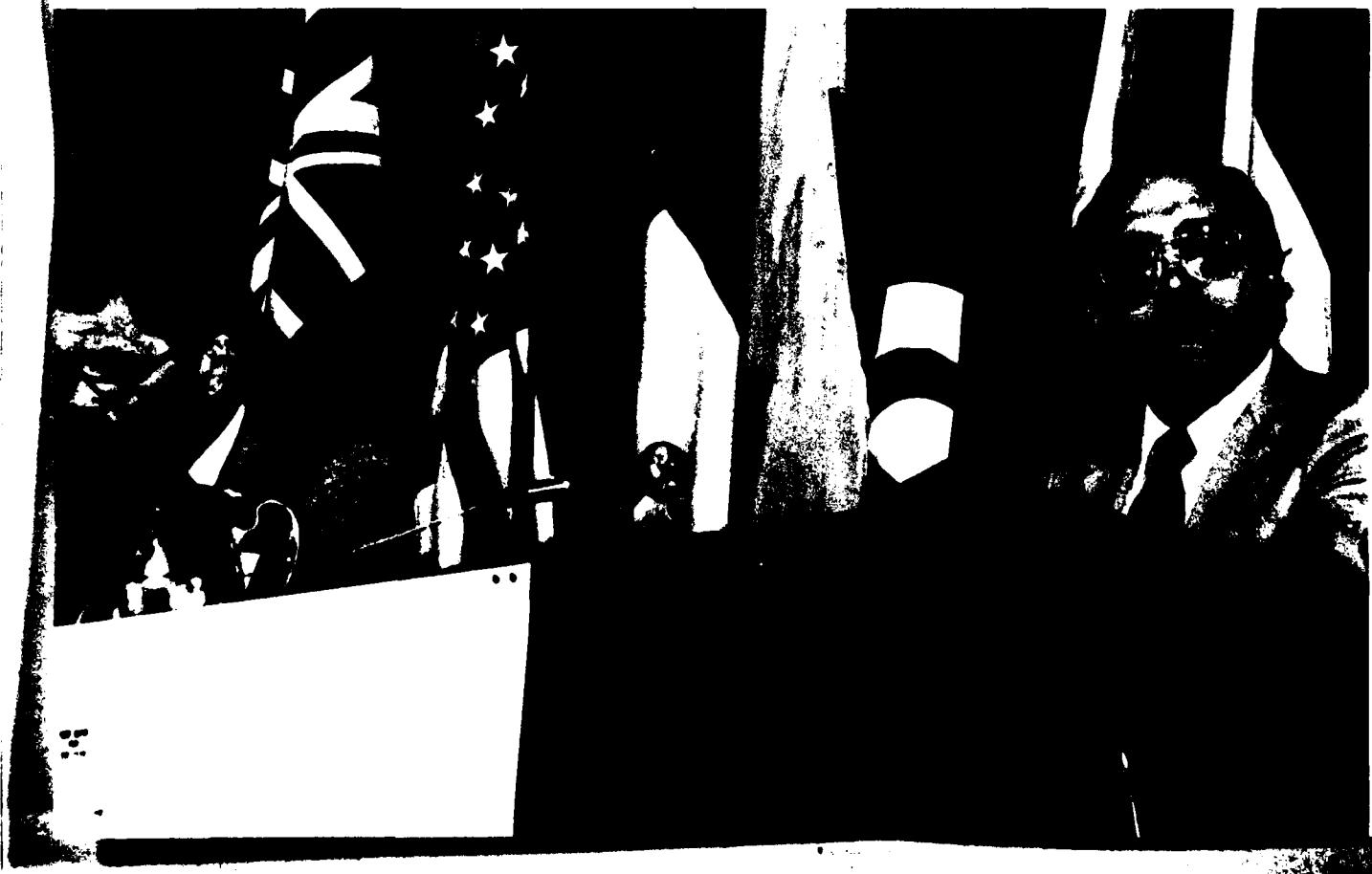
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**SOCIALIST PLURALISM IN POLAND: IS COMMUNISM READY TO REFORM?**

**Researcher:** Assistant Professor Arthur R. Rachwald

This is a study of the Polish triad of the Communist Party, the Roman Catholic Church and Solidarity, the free and self-governing union. For 35 years, politics in Poland were a function of an ambivalent relationship among these socio-political forces, which despite their contrasting ideologies have a shared patriotism, and around this established a modus vivendi. But Poland's pluralism is de facto and has not been institutionalized. As a consequence, Poland has a minority government, which is the principal source of instability in the country.

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RESEARCH COURSE PROJECTS

POLITICAL SCIENCE DEPARTMENT

A PROPOSED OCEAN POLICY FOR THE UNITED STATES

Researcher: Midshipman 1/C Kevin A. Boreen

Adviser: Captain Joseph A. Jockel, USN

The security of the United States is closely linked to the seas. Consequently the United States should establish national ocean policy objectives and attain them. Decision making in the past four decades has not followed a "rational actor" approach but has been a product of organizational processes and bureaucratic politics. This has been particularly evident in the Third U. N. Conference on the Law of the Sea which recently adopted a comprehensive Law of the Sea convention.

Two issues affected by the treaty are of great concern to the United States. The first is freedom of the seas, a right which makes the projection of military power possible. The second is the right to exploit the minerals of the sea floor. The United States is heavily dependent today upon foreign sources of critical minerals, minerals available on the ocean bottom. The treaty would effectively discourage the exploitation of these resources by placing control of them into the hands of a supranational U. N. bureaucracy. Originally the U. S. made this concession to gain transit rights. Today the United States is correct in opposing the Convention on the Law of the Sea. The sea floor should be exploited unilaterally by the U. S. and its mining activities should be protected as should the exercise of any other high-seas freedom.

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A STUDY OF PAST AND PRESENT SENATE-SEEKING CONGRESSMEN

Researchers: Midshipmen 1/C Joseph Direnzo and Peter Nickitas

Adviser: Associate Professor Stephen E. Frantzich

The project analyzed, first, the behavior of current senators who were once members of the House of Representatives and, second, eighteen current members of the House of Representatives who were contemplating a run for the Senate in 1982. Nine criteria, considered to be indicative of preparation for a run for the Senate, were reviewed. These criteria included: (1) increases in communications to constituents; (2) rises in the numbers of trips home taken as the senatorial elections drew near, (3) increases in the number of bills sponsored and co-sponsored in the sessions prior to the

respective senatorial elections, (4) electoral margins of ten percent or more, (5) marked political shift to the right as measured by ADA, ACA, COPE, and American Security Council yardsticks, (6) occupations (with professionals more likely to run for the Senate), (7) age (with 55 as the ceiling for likelihood of candidacy), (8) terms served in the House (with four terms as the likelihood ceiling), and (9) the size of the home state, with states containing four or fewer congressional districts being more conducive to a senatorial candidacy. The data sources in addition to standard literature on congressional politics included letters from Congressmen and Senators, information from The Almanac of American Politics and Clerk of the House Reports, and Congressional Quarterly.

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#### U. S. INTERVENTION IN THE DOMINICAN REPUBLIC

Researcher: Midshipman 1/C Krista A. Hagmann

Adviser: Professor G. Pope Atkins

The United States conducted military interventions in the Dominican Republic in both 1916 and 1965. Although separated by almost fifty years, U. S. policy was, in both cases, strikingly similar as well as having distinct features. Consideration of the eight year occupation beginning in 1916 and the subsequent Trujillo election reveals that the immediate U. S. objective was stability and the ultimate goals were constitutional democracy and military reform. The conclusion inspired by a comparison of these objectives and the actual consequences of occupation is that U. S. action appeared to meet with initial success but eventually democracy gave way to dictatorship. A similar analysis of the 1965 intervention uncovers objectives differing only slightly from those of the first occupation. In the short run, U. S. objectives expressed the sentiments of the Cold War by coupling the goal of stability with the prevention of a Communist takeover of the island. The long term goals remained the same even after fifty years. Again consideration of the consequences of the intervention leads to the conclusion that the apparent U. S. success was short-lived and long run objectives were not met. Although the interventions differ in time period and length of U. S. occupation, a comparison of their outcomes allows two generalizations about the hemisphere. First, military intervention is not currently a viable U. S. policy choice, and second, democracy cannot be exported. The paper was presented at the Middle Atlantic Conference on Latin American Studies, Johns Hopkins University, on 2 April 1982.

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RESEARCH COURSE PROJECTS

POLITICAL SCIENCE DEPARTMENT

**THE SOVIET NAVY AS A POLITICAL INSTRUMENT**

Researcher: Midshipman 1/C Wilburn K. Hall

Adviser: Associate Professor Rodney G. Tomlinson

The research undertaken here examined the phases of Soviet Naval development with emphasis on the Gorshkov period and the inferred political utility of the weapons platform. By examining weapons-mix one is able to detect salient functions that offer insights into Soviet political goals. This research is original in that it quantitatively and qualitatively examines Soviet naval development longitudinally through time from 1952 to the present, while attributing political utility to weapons systems and platforms. To the present it appears that the Soviets have systematically created a balanced force that infers policies of intervention, logistical (and combat) support for "wars of national self-determination" and power projection in support of diplomatic undertakings. Awesome new platforms like the Kirov class nuclear powered battle-cruiser suggest dual roles like diplomatic coercion (gunboat diplomacy) and confrontational tactics against the U. S. fleet.

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**A POLITICAL ANALYSIS OF THE SAUDI PRESS**

Researcher: Midshipman 1/C Doman O. McArthur

Adviser: FSO-4 John Limbert

The purpose of this project was to study Arabic publications, in both Arabic and English languages, with a view to gaining insights into the political and cultural climate of the Kingdom of Saudi Arabia. Key areas studied were: (1) Saudi views of its role in the Middle East, (2) Saudi political climate as reflected in its journalism, and (3) Saudi views of U. S. policy in the area, especially Saudi relations. It was also intended to enhance the student's Arabic language skills. The final lengthy report, written in both Arabic and English, included a compilation of findings as well as translations of key articles.

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**NATIONALISM IN THE SOVIET REPUBLICS**

Researcher: Midshipman 1/C Michael J. Norton

Adviser: Assistant Professor Gale A. Mattox

Nationalism has been a potent and active force around the globe in the twentieth century, changing maps constantly in Europe, Southern Asia, and Africa as colonies became independent, new nations formed around ethnic groups, and attempts at unification were successful in some cases, foiled in others. A nation as large as the Soviet Union stretching from the Baltic and Black Seas in the west to the Arctic and Northwest Pacific and containing over one hundred different nationalities and languages has potential for nationalist conflict. Should the Soviets continue with their present policies of Russian dominated structures and restrictions on religion, they could create a volatile situation. Demographic trends indicate a Russian minority in the future and rapid growth in Islamic Central Asia. It is this area which appears most explosive, considering the major religious, ethnic, and historic conflicts with Russian society. As the non-Russian population increases, their demands for participation in the Presidium, party, and military will increase. Their desire for regional autonomy might also increase. The safest prediction is that the Soviets will find themselves in a position in which they can no longer afford to ignore their own official policy of equality among the nations.

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COCHRAN, Charles L., Professor, "Ocean Thermal Energy: Foreign Energy Policy toward Developing Nations," Sell Overseas America, 2(August-September 1981), 4, 9, and 11.

This article detailed how U. S. economic and energy-policy interests coincided with the interests of LDC's located in areas with acceptable ocean thermal resources (approximately 77 nations). Their need to reduce the importation of high-cost fossil fuels and replace it with an indigenous (competitively priced) source of reliable energy provides the U. S. with the opportunity to develop and sell or lease OTEC to these governments. This technology transfer would assist the U. S. in its own balance of payments problems and reduce world demand for fossil fuels.

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FITZGERALD, John A., Professor, "Changing Patterns of Officer Recruitment at the U. S. Naval Academy," Armed Forces and Society, 8(Fall 1981), 111-128.

This article is an empirical list of Morris Janowitz's hypotheses regarding changes in officer recruitment since World War II. Janowitz offered five generalizations. His generalizations were tested for the fifty-year period 1925-1975. The study found that since 1955: (1) there has been an increase in the number of midshipmen recruited from working class families; (2) recruitment from professional and business families have decreased; (3) recruitment from the high-status Protestant denominations has declined; (4) recruitment of sons of non-commissioned officers has increased; and (5) recruitment of midshipmen from minority backgrounds has increased.

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PUBLICATIONS

POLITICAL SCIENCE DEPARTMENT

FRANTZICH, Stephen E., Associate Professor, "Citizens in Uniform: Political Participation Among Military and Civilian Samples," Journal of Political and Military Sociology, 10 (Spring 1982), 15-28.

Using a national sample of former NAFAC participants, this study shows that among matched individuals, military status and military academy experience retard political participation in those areas where military personnel have full legal and constitutional rights to exercise their roles as citizens (voting, writing letters, etc.). Questioning the common rationalization that inconvenience reduces participation for military personnel, the analysis concludes that the participatory retardation remains well after individuals return to civilian life and are no longer subject to the inconvenience factors. It seems clear that the military in general and military education in particular socialized its members into attitudes which discourage their members from taking advantage of the very rights they stand ready to protect for their fellow citizens.

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LIMBERT, John, FSO-4, "Nest of Spies, Pack of Lies," The Washington Quarterly, 5 (Spring 1982), 75-82.

This article addressed the question of the exposure of alleged Embassy documents by the "Moslem student followers of Imam" in Tehran. It views the exposures as part of the ongoing turmoil within Iranian domestic politics.

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RAU, Robert L., Professor, "The Role of Singapore in ASEAN," Contemporary Southeast Asia, 3 (September 1981), 99-112.

This article discusses the evolution of the Association of Southeast Asian Nations, from 1967 to 1981, from the perspective of Singapore's participation. Singapore's activities in the organization have been highlighted in the political and economic development areas. Singapore has over time found that it is the atypical state of the five member states. Singapore is essentially different because of its geographic position, small population, Chinese majority, and economic success. Singapore's rate of economic development and commercial success enables it to compete on the same level as Japan and Taiwan. The remaining four states of Malaysia, Thailand, Indonesia and the Philippines have had to adjust to these realities. Singapore is regarded as the loyal but persistent critic and goad to progress within the organization.

\*\*\*\*\*

RAU, Robert L., Professor, "Southeast Asian Security in the 1980s: An Intraorganizational Perspective," U. S. Foreign Policy and Asian-Pacific Security, A Transregional Approach. William T. Tow and William R. Feeney, editors, Boulder, Colorado: Westview Press, (1982), 89-115.

This chapter discusses security in Southeast Asia and specifically within the ASEAN area. Four central topics are examined: the evolution of ASEAN strategic perceptions and responses from 1967 to 1978; current security problems; specific issues related to maritime security and possible ASEAN prescriptions for its future defense. A central theme in this chapter is the ASEAN solution to its security problems. Institutional solutions are described (SEATO or a like organization) as well as more informal bilateral approaches to specific security challenges.

\*\*\*\*\*



PRESENTATIONS

POLITICAL SCIENCE DEPARTMENT

FRANTZICH, Stephen E., Associate Professor, "Continuity and Change in American Politics in the 1980s," Washington WINTERIM Seminar, Washington, D. C., January 1982.

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FRANTZICH, Stephen E., Associate Professor, "Relations Between the Social and Physical Sciences," Liberal Arts in a Technical Curriculum Conference, U. S. Naval Academy, Annapolis, March 1982.

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HAGMANN, Krista A., Midshipman 1/C, "U. S. Intervention in the Dominican Republic," Middle Atlantic Conference on Latin American Studies, Johns Hopkins University, Baltimore, Maryland, 2 April 1982.

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LIMBERT, John, FSO-4, "Cultural Factors in the Iranian Revolution," Cathedral of St. John the Divine, Cathedral Peace Institute, New York City, April 1982.

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LIMBERT, John, FSO-4, "U. S. Policy Toward the Middle East: Why a Fiasco?" Near East Center, Princeton University, November 1981.

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LIMBERT, John, FSO-4, "Whither Iran?" Near East Center, Princeton University, November 1981.

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MOORE, Richard S., Captain, USMC, "The General Staff Concept: An Institutional Answer to JCS Deficiencies," U. S. Naval War College Off-Campus Seminar, Washington, D.C., May 1982.

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MATTOX, Gale A., Assistant Professor, "The Limits of FRG International Involvement: The Case of Arms Sales to Saudi Arabia," International Studies Association, Cincinnati, Ohio, 24 March 1982.

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PRESENTATIONS

POLITICAL SCIENCE DEPARTMENT

RACHWALD, Arthur R., Assistant Professor, "Politics in Poland:  
Security vs. Democracy," Western Slavic Association Conference,  
Honolulu, Hawaii, 18-20 March 1982.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)  This annual report summarizes the research work of the Naval Academy faculty and midshipmen for the period July 1981 through June 1982. Sponsored and independent research projects are listed by title, followed by the names of the investigators and an abstract. A list of publications and their abstracts are included as well as presentations at professional meetings, conferences, and seminars.		

